

Shackleton's ship the *Endurance* imprisoned in the ice of the Antarctic in 1915

QUEST AND CONQUEST

By

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Introduction

A CENTURY and a half ago the men who had made the French Revolution thought that they had invented liberty and that a new era had dawned for mankind They claimed to have brought in the age of Reason, which they celebrated by dancing in their grand old cathedral of Notre Dame in Paris

They were right, though they did not understand how or why A new era had in fact dawned, the turning-point in the history of humanity In all the practical things of everyday life they still belonged to the past for no progress was yet to be seen But the gulf that divides us to-day from those Frenchmen of a hundred and fifty years ago is greater than the gulf which separated them from the artists of Tutankhamen in Ancient Egypt and the sanitary engineers who built Mohenjo Daro in Sind perhaps five thousand years ago

Half a million years ago, perhaps, primitive man had learnt the mastery of fire, which, with articulate speech, first marked him from the brutes Far, far later perhaps about ten thousand years ago, he made the greatest inventions that have affected human destiny , the art of growing the fruits of the earth, of going upon the face of the waters in boats and the use of the wheel He had, too, tamed wild animals, to make use of them for his own purpose the jungle fowl, the sheep, goat, bull camel and others, and his noblest conquests of all the dog and the horse

During the many thousand years that have elapsed since, only three inventions of prime importance have been made which have had deep influence upon the ideas of mankind, for it must be realized that ideas are more powerful than deeds First, the art of writing, that is, of inscribing thoughts so that they can be handed on through space and time Secondly, the invention by the Chinese, nearly two thousand years ago, of paper the best medium to make the passage of those thoughts still freer Thirdly, the art of printing, believed also to have been used by the Chinese in ancient days, but made real and useful by Gutenberg, a German, less than six hundred years ago By this art the exchange of thought has been made freer still, and so general education has been rendered possible And in all this long time there has been only one really great discovery, that of the New World

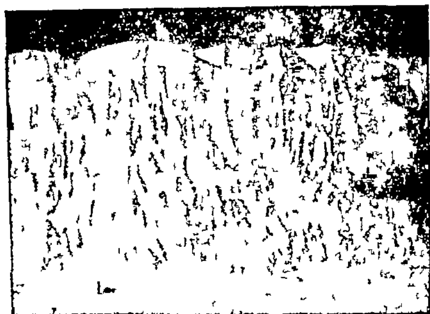
When, in 1812, Napoleon raced from Moscow to Paris to save his throne, he had no means of travel more speedy than had Alexander the Great in the fourth century before Christ or than Julius Caesar three hundred years later, for transport was still dependent upon the horse Nor could he send even most urgent despatches more swiftly than Genghiz Khan in A D 1220, or Akbar in 1600, for signalling was still dependent upon flag or fire Much less than a hundred years ago, when men and women wished to travel from England to India, they were still dependent upon sails and the wind, and their route lay round the Cape of Good Hope There had been no speeding up of navigation since Hanno of Carthage had sailed round the west coast of Africa five centuries before Christ

Medicine was still mostly a matter of herbs and simples, when the wise women of the countryside made better cures than many a doctor To enter a hospital was a terrible risk, and to face an operation meant certain agony and almost certain death Mosquitoes still spread unsuspected the ravages of malaria, and in crowded cities, camps and prisons the death-rate was appalling, for typhus, typhoid, cholera, small-pox and bubonic plague still raged about the world unchecked

Half the world did not know the other half, in spite of the dauntless work upon the seas of early British, Dutch and Portuguese navigators Discovery had been made by water, and, though the coasts of the world were fairly well-known, the interiors of the continents were still marked white upon the map In the middle of the reign of Queen Victoria the Royal Geographical Society of London knew no more about the sources of the Nile than did Ptolemy in the year A D 150, and they still refused to believe the true things that Herodotus, the Greek historian, wrote in the fifth century before Christ In the eyes of Europe and Asia Africa was still the Dark Continent with but a few settlements dotted round the coast, like buttons on an overcoat Australia was still less known, and apart from a handful of Europeans on a few favoured parts of the coast, was inhabited only by some wandering tribes of natives still in the culture of the Stone Age In the New World, the northern wastes of Canada were still unexplored, the United States had not yet sprawled across to the Pacific and the Mississippi was still uncharted In South America vast areas were still inhabited only by

naked savages with poisoned arrows Asia, the ancient home of civilization, was slumbering

Railways had scarcely grown out of the narrow tracks laid for the haulage of tubs in English mines, and the possibilities of steam were realized only by a handful of far-seeing men Electricity was still the plaything of experimenting philosophers, and its offspring was not yet conceived, namely the telegraph, the telephone, electric lighting, heating and traction, the harnessing of the waterfalls of the earth to send their tremendous power over vast distances, and all the countless uses of the electric current in the factory and the home There was yet to pass a whole century before the mysterious current should surpass its own marvels by giving us telegraphy without wires, which was to lead to broadcasting There was to be another half century still before men would dream that it could be possible to talk over the air, to send pictures even, without the help of wires, much less to cast the image of moving things upon a distant screen From 1800 three generations of men passed before chemists stumbled upon the miracle of radium, which was to turn the ideas of earlier philosophers inside out The use of mineral oil for burning was known to but a few, and so the invention of the engine which is driven by the explosion of oil gas inside a cylinder had not yet given men the motor-car or made possible the conquest of the air Then twenty miles an hour was thought a breakneck speed To-day men have moved at three hundred



The face of a glacier in the Antarctic

I

QUEST

The Lure of the Unknown

VARIED are the motives that lead the bolder spirits of mankind to explore the earth Some venture for gain and cheerfully face hardship and danger in order to find wealth, fresh fields for their activity, new territories for their countrymen, new routes for their trade, new markets for their goods The marine authorities and all who have to do with ships need knowledge of the seas and the coasts, and the sailors of the world are not content so long as one mile of coast remains uncharted

Rivalry spurs men on to great deeds, the keen desire to outdo others, to be the first to make new discoveries or to reach new goals. Greater still is the scientific curiosity, the intense desire to *know*, which has urged men even farther Why else did August Piccard venture ten miles up into the air?

There is, too the lure of the Unknown, that mysterious appeal that for some men gives waterless deserts a charm, endless ice and snow a fascination. Neither reeking forest, nor fear of deadly reptiles and insects, of savage beasts and still more savage men, of mortal disease, of death from hunger or from thirst has ever daunted the finer sort of men, even *if there be no material reward to win*

But noblest of all is that urge which sees in the virgin peak of Everest a challenge and an inspiration Why else should men strain and struggle to reach it? It is not for gain, nor wholly for glory *Mount Everest to-day is far more than the highest* mountain in the world It is the symbol of the loftiest heights of man's imagination The motive that drove young men to risk everything upon those forbidding pinnacles was not physical, but spiritual so that the humblest invalid, losing hope in an unequal struggle might take heart from their example, when they read of that supreme test of human endurance



Eskimos in their kayaks

The Arctic

To the sea-faring peoples of the north the Arctic has ever acted as a lure It was natural, therefore, that when the Napoleonic wars came to an end, experienced British sailors should turn their energies from fighting men to fighting ice and snow, and find scope for their ambitions in the Arctic cold and gloom The Admiralty was anxious to know if there was a way for ships to China and the East Indies by the north-west, and there was an outburst of active exploration in the north of Canada Thus was the old hunt for the North-West Passage once more renewed

Two centuries previously bold English sailors had shown the way Martin Frobisher in 1576 John Davis in 1585 Henry Hudson in 1601-10 and

William Baffin in 1615, all of whom have left their names upon the map of the north

The first of the new adventurers was Captain Scoresby, who found the icy seas more open than he expected This was in 1817 Two ships followed a couple of years later under the command of Lieutenant Franklin, but returned without great result Another under Captain John Ross and Lieutenant Edward Parry sailed in 1818, and opened new fishing grounds in Baffin Bay In the next year Parry made a second journey, in which he sailed round from Greenland to the Behring Strait, and so proved that the North-West Passage does exist The results of these journeys were so important that in 1821 he undertook a third, always breaking new ground In the meantime his friend Franklin had been exploring the Coppermine river, but had been driven back by the two great enemies of polar exploration, cold and starvation

In 1824 Parry left again, and in 1825 and 1826 Franklin led his second expedition They found much that was new, mapped new coasts and returned to England in 1826 Three years later John Ross started on his second journey this time taking his nephew James, who was to earn undying fame in Antarctic exploration They spent four ye[illegible] surveying in the north, and hoisted the British fl[illegible] at the magnetic pole In the absence of news, th[illegible] was much anxiety about their fate, and a rel[illegible] expedition was sent out under Sir George Back w[illegible] had been as a boy w[illegible] Franklin The R[illegible] however, had been [illegible] by a whaler brought home Bac[illegible] h his ship in sinking condition



The *Erebus* and *Terror* fighting through an ice pack in a gale

Meanwhile, good surveying work had been done in the north by men employed in the fur trade by the Hudson Bay Company The growing knowledge encouraged Franklin to start upon a great expedition in 1845, which had a tragic end Sir John was no longer a young man when he sailed with the two ships *Erebus* and *Terror*, in which Sir James Ross had been doing grand work in the Antarctic Franklin and his party disappeared into the frozen wastes In 1848 a relief expedition was sent to look for them under Sir James Ross They found nothing, and their return without news shocked England Many relief expeditions were organized The first man to bring back any information was Sir Erasmus Ommaney, who found some of their relics at their old winter quarters on Beechey Island M'Clue actually traversed the North-West Passage, for which he received not

only the honour of knighthood like Parry, Franklin, the Rosses and other great Arctic explorers down to our own day, but a share of a grant of £10,000 voted by the Houses of Parliament to him, his officers and crew It was not until 1858 that any news was brought of the Franklin expedition, when Dr Rae picked up tidings of their fate from the Eskimos and so earned the reward of £10,000 offered by the Admiralty for definite information

After the failure of the official relief expeditions the British public was so deeply moved that funds were raised by subscription to enable Lady Franklin, who devoted all her own resources to the task, to send yet another Lieutenant, afterwards Sir Leopold McClintock, a specialist in sledge work, sailed in the yacht *Fox* In 1860 he brought back the first tangible relics a skull, a piece of tattered serge, and an oak strip from a sledge, found at Thunder Cove, Adelaide Peninsula ten miles from King William Land, where the *Erebus* and *Terror* had been abandoned in April 1848 The party had been sighted by a whaler near Lancaster Sound on July 26th, 1845, and an old Eskimo woman afterwards told how 'the Englishmen fell and died as they walked' Thus perished Sir John Franklin and the whole party of a hundred and twenty-nine officers and men But they had not died in vain for the search for their remains, which in twelve years had occupied no fewer than thirty-nine expeditions, led to the survey of some seven thousand miles of coastline and the exploration of a vast extent of unknown country The epic of polar exploration is indeed a wonderful story of human courage and endurance, inspiring to read

Recently there has come a romantic reminder of the heroic past. It had been suggested that the failure of the Franklin expedition had been due, at least in part, to badly preserved food. Eighty-one years afterwards, one of their caches was discovered and a tin of beef, sealed on Beechey Island in 1850, was opened in a Liverpool laboratory in 1926. It was found to be still in good eatable condition.

Much had Englishmen struggled and suffered to make that North-West Passage, yet it was reserved for a Norwegian to be the first to sail right through in one ship. His name, which was to become famous for other exploits too, was Ronald Amundsen.

Meanwhile Russian explorers had been doing good work on the north coast of Siberia and in 1875 Nordenskjold, a Swede who had learnt exploration in Greenland, made a voyage to Zemlya. In 1876 he was the first to reach the mouth of the Yenisei. In 1878 he made another journey, in command of the *Vega* and the *Lena*. He did much valuable scientific work, surveying the coast, taking soundings of the seas, making records of the weather, observing marine currents and animal life. On August 19th, 1878 he fired a salute off Cape Chelyuskin, the mostly northerly cape of the Old World. In that month the *Lena* sailed up the river after which it was named as far as Yakutsk and the *Vega* continued surveying the Siberian coast making many discoveries. On July 18th 1879, Nordenskjold cleared the most eastern promontory of Asia, which he named Cape Deshev, after the gallant Cossack officer who had been the first to sail round it two hundred and thirty years previously. Nordenskjold

ranks among the great scientific explorers of the world

Other Norsemen, too, did fine work in the Arctic One of the most famous was Fritjof Nansen, who won his spurs by crossing Greenland from west to east in 1882, which Nordenskjold had tried in vain to do In 1893 he formed the bold project of allowing his ship to be frozen into the ice, as he was convinced that she would then drift right across the North Pole, which had by now become the aim of all polar exploration He had a ship specially designed to resist the great pressure of the ice, the *Fram* She actually was frozen in for three years, and, although Nansen did not reach the Pole, he showed that he was right in maintaining that the North Pole is a deep sea covered with ice Nansen, with one companion, spent an entire winter in a hut in the Arctic, living upon walrus meat and blood mixed with flour They forgot what it feels like to wash, and Nansen said that the first thing he noticed when he met the English traveller Jackson on Franz Josef Land was that he smelt of expensive English soap

A Swede named Salmon Andree started upon an attempt to reach the North Pole which was as original, if not as foolhardy, as it was brave He went in a balloon, from Spitzbergen, on July 11th 1897 and vanished On August 8th 1930, a party of explorers found an old camp on Whale Island or Giles Land, with human remains, among them the body, well preserved, of Andree He and his companions had clearly succumbed to hunger and cold Thus after thirty-three years did the ice deliver up its dead, and Andree's body was



H G Watkins explorer in his kayak

brought to Stockholm for public funeral

In the New World the good work was carried on by Stefansson who showed that the Arctic is not wholly desolate that there is meat there for those who know how to get it He lived among the Eskimo for four years with hardly any baggage

except his rifle and ammunition to shoot game for food He is one of the very few Europeans who have learnt the language of the Eskimo properly, and he has shown that they have developed a way of living exactly suited to the climate If they are persuaded to live in wooden houses and behave like Europeans, they become ill and fade away It is a remarkable fact that their implements, from needles, awls and fish-hooks to spear and harpoon points in bone and ivory, are very similar to those of the men of the last phase of the Old Stone Age in Western Europe, who lived under similar conditions amid ice and snow Still more remarkable is the fact that they are also almost identical in physical structure, and it has been suggested that the Eskimo of the north of Canada to-day are the direct descendants of the men who hunted reindeer in Europe at the close of the Great Ice Age

The conquest of the air opened a new era in polar exploration In 1924, Binney, leading an Oxford University Expedition, used a seaplane for surveying and photography in the Arctic, in North-East Land In 1925 Amundsen tried to fly to the North Pole but the first man to reach it by air was Commander Byrd of the United States Navy, who left Spitzbergen on May 9th, 1926, flew over the Pole and returned This was done in fifteen hours! What a new epoch in polar exploration! Two days later Amundsen, with Ellsworth and an Italian named Nobile, reached the Pole in a semi-rigid airship in sixteen hours In 1928 Wilkins flew in twenty hours from Alaska to Spitzbergen, a distance of 1,200 miles In that year Nobile flew an Italian airship to the Pole, but he was wrecked on

the return journey, and Amundsen lost his life in trying to rescue him

In 1930 a young Cambridge undergraduate, H G Watkins, formed the idea that there might be a short air route between London and Canada by way of Iceland and Greenland This attracted attention afresh to that great ice-covered land, which had in the past been a schooling ground for many famous explorers Watkins did such splendid work that he was awarded the Gold Medal of the Royal Geographical Society of London He returned to Greenland to continue, but while hunting for food in his *kayak*, or Eskimo canoe, he lost his life It was a tragedy for Arctic exploration that a career so brilliantly opened should be cut off on the threshold of manhood

Other men carried on the work The British Arctic Air Route Expedition lasted from July 6th, 1930 until October 1st, 1931 In order to carry out observations on the weather through that long and cruel winter, Courtauld allowed himself to be frozen in, confined to his snow-buried hut on an ice-cap from December 6th 1930 till May 1st, 1931

Older men were not to be outdone and the veteran French polar investigator, Jean Baptiste Etienne Charcot, set off in his yacht, the famous *Pourquoi Pas?* This fine old savant, who had already attained high rank in the literature of polar exploration, was wrecked by a hurricane on his way home from Reykjavik to Copenhagen on September 17th, 1936, and perished in his sixty ninth year, with all his crew but one

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tions in the north and with a severely practical object They are straining every nerve to establish industries and towns in the extreme north of Siberia, on the shores of the Frozen Ocean, as they call the Arctic Sea, and have put up an extensive series of meteorological stations, which report on the conditions of the atmosphere, pressure and currents, to enable the central stations to make useful forecasts of the weather Prince Rudolf Island, near Novaya Zemlya, boasts of being the northernmost radio station in the world How remote this spot is can be realized when we learn that the journey from Archangel the most northerly town in Russia, is about 2,500 miles

The Antarctic

THE story of the South Pole is as romantic and full of tales of courage and hardihood as that of the North Captain Cook was the first to pay a visit to the Antarctic continent, but he did not land In 1819-20 a Russian, Admiral Bellingshausen, spent two years surveying there, and his efforts were rewarded, for he was the first to discover land within the Antarctic Circle He called it Peter I Land On this great survey he sailed completely round the Pole.

One of the earliest pioneers was a sailor named Weddell, who was seal-hunting In 1819 he found the sea that now bears his name Next year an Englishman named Edward Bransfield found a cape which he called Trinity Land, which was discover-

d independently a year later by Captain N B Palmer, an American sealer, after whom it was ong known as Palmer Land A recent survey has hown that Trinity Land is a part of the Antarctic Continent, so the honour of being the actual discoverer of the great white continent belongs to Edward Bransfield In 1831 another Englishman Captain Biscoe, called a new cape that he had found Enderby Land after his employers, and a ittle more than a century later, Sir Douglas Mawson showed that this too, was part of the mainand

Great interest was roused in Europe by these discoveries of a new part of the world, and in 1938 a French expedition left under Captain J S C Dumount d'Urbeville to whom was long given the honour of being the first actually to sight the continent itself, on January 20th, 1840 Two years later an American, Lieutenant Wilkes, was in the same waters and although he sighted the French ships, through some misunderstanding the two expeditions did not meet

In 1839 an important expedition left England under the command of Captain James Ross already known for his work in the Arctic with two ships destined to become famous, the *Erebus* and the *Terror* The main object of his voyage was to study the magnetic conditions a subject upon which he was an authority He found lofty mountain ranges and peaks running up to 10,000 feet He hoisted the Union Jack but apart from his crew, the only witnesses of the ceremony were the uncountable penguins which gazed on without emotion Ross next discovered, to his surprise,

two volcanoes, which he named after his vessels Mt Erebus and Mt Terror In 1842 he undertook a second voyage, but this time he was unlucky and only his splendid seamanship averted a disaster He made very important scientific observations and still more important discoveries

Then there was a pause in Antarctic exploration In 1895 Larsen landed, the first man to set foot on the mainland itself, and in 1898 a Belgian expedition carried on much detailed scientific investigation In the same year Borchgrevink, one of Larsen s men, penetrated farther south than anyone yet

The turn of the century saw still more expeditions Commander Scott led one in a specially built boat, the *Discovery*, in August 1901, with a young officer, by name Ernest Shackleton, on his staff The expedition was not sensational, but produced valuable scientific results Sledge-journeys into the interior showed the existence there of a great plateau nearly 10,000 feet above the sea In the same year a German expedition was led by Professor Drygalski, which discovered Kaiser Wilhelm Land, Nordenskjold came down from the north to explore Graham Land and Bruce in the *Scotia* surveyed the Weddell Sea and found Coats Land That keen French explorer, Charcot, in the *Pourquoi Pas?*, made important discoveries on two expeditions in 1903 and 1908, and found more land, which he named after his own father and presidents of the French Republic

In 1907 Ernest Shackleton, profiting by the experience he had gained with Scott, sailed in the *Nimrod* with a scientific staff He completed a



Scott at home in the Antarctic writing his diary

remarkable land journey, passing the 'Farthest South' yet reached by man on November 26th On January 9th, 1909, his party marched to 88 23 S, where they hoisted the Union Jack and left a brass cylinder containing records for some future explorer to find If only their supplies had held out they could have reached the Pole itself

Although he had not succeeded Scott determined that it should be an Englishman who would first reach the South Pole, and in 1910 he led his second expedition with this express object On January 9th, 1912 Scott with his handful of resolute men, doggedly tramping through the blizzards over those eight hundred miles of ice, passed Shackleton's 'Farthest South' point, and on the 16th they reached the Pole itself for which they had striven so hard and suffered so much

The grisly spectre of death had been dogging their footsteps but it was the Pole itself that gave them the first blow, for there *they found a sleigh* runner with a piece of black flag attached Amundsen, the Norwegian, had been there before them H had in fact, reached the South Pole on Decembe 14th, 1911, only four weeks earlier!

The disappointment was heart-breaking The turned to struggle back 'My God! This is a *awful place!'* wrote Scott in his diary Yet thes dauntless men made their notes and collecte fossils of priceless scientific value as they fough their way back through the blizzards Those fossil tell us that there is coal in the Antarctic, and tha once upon a time those hurricane-swept, frozen lands enjoyed a mellow climate

The tragedy that was brooding over them then struck On February 16th Seaman Evans, who *had been selected for the expedition on account o* his great strength collapsed The strain and disappointment drove him out of his mind, and he died Then one of the officers, Oates saw that there were not enough supplies for all, but that if one fell out, there was hope for the others So he said to his friends, 'I am just going outside, and *may be some time'* He then walked out of the tent into the blizzard, and that 'some time' was eternity The three left fought on They managed to drag themselves to a depot where they had left food and there they, too, died

A relief expedition afterwards found their remains, with notebooks and the specimens which throw *a flood of light upon the continent* In one of the books were Scott's farewell words 'These

rough notes and our dead bodies must tell the tale'

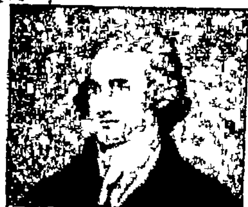
More scientific expeditions followed Sir Douglas Mawson, who had been with Shackleton in 1901, did valuable work on his expedition to Victoria Land One of his companions fell into a crevasse and was killed, and another died in Mawson's arms In 1913 Sir Ernest Shackleton once more led an expedition, on the *Endurance* After unbelievable suffering, the party reached South Georgia, and all but three were saved from a fate like Scott's When the Great War was over Shackleton returned to his old love and sailed on the *Quest* to carry out research among the islands Once again the South claimed its victim, for he died in South Georgia at 3-30 a m on January 5th, 1922, of an attack of angina pectoris His name takes its place with those of the greatest explorers of the world

The new era led to the use of aeroplanes here, too Sir Hubert Wilkins made valuable surveys, as did the American Admiral Byrd Rising above the 10,000 feet range, he flew over the Pole a distance of 800 miles and back in nineteen hours That enabled him to realize what a tremendous fight with hunger and death had been those toiling journeys of Scott and Shackleton, crawling along down there on the land

And so the work goes on There are still something like two thousand miles of coast to be charted, and men for the work are always forthcoming

Africa

THERE is an old saying that out of Africa there ever comes something new, and, during the past hundred and fifty years, brave men have forced their way into her heart and brought back a remarkable series of discoveries It is within the memory of men still living that the middle of Africa was left white upon the maps, quite unknown, and before that the map-makers put wild pictures of lions and elephants there As the poet Swift remarked



Mungo Park

> Geographers in Afric maps
> Make savage pictures fill their gaps
> And o'er inhabitable downs
> Place elephants in place of towns.

Only the coast was known Europeans had towns at Loanda, at Cape Town and elsewhere, but never went far inland They knew something about the mouths of the great rivers, but did not know where their waters came from

A great puzzle was the Niger In 1788 an Association was formed in London to explore it. Neither its direction nor its source was known, and then not even its mouth The Association sent out

four expeditions, but the country was so unhealthy and the natives so fierce that all the explorers died or were murdered

Then a Scottish doctor, Mungo Park, who had travelled in Sumatra, volunteered He went first to the Gambia to study the Mandingo language and customs and then started up-country The King of Woolli received him well, but told him that farther up, where no white man had yet been seen, they would be sure to kill him Not afraid, he went up into the country of the Moslem Fulahs, where he created quite a stir among the King's wives, who teased him about his white skin and prominent nose Escaping with difficulty, after being robbed several times and imprisoned once, this dogged man carried on his journey, even without his interpreter and servant On July 20th, 1796, he reached his goal and wrote that he had found 'the majestic Niger flowing slowly to the eastward'

Weak from fever, in rags and poverty, he tried to return to the Gambia choosing a different route On the way bandits took the last few possessions he had, and when he reached the friendly Mandingo country again he had nothing at all left The local governor recovered his horse and clothes for him, and a slave-dealer took pity on him, giving him a home for several months while he lay desperately ill from fever Mungo Park was moved by the sufferings of the slaves, for the Black Continent from end to end was the very home of slavery He wrote that three-quarters of the people were slaves, living in misery, with no hope being flogged killed or abandoned to wild beasts for the slightest whim yet these poor down trodden creatures showed him great

kindness His description of their misery helped to move Bishop Wilberforce to his great campaign against the slave trade, which eventually led to the abolition of that curse

When Park reached Gambia he was so much altered in appearance that his friends thought he was a ghost He had not been able to follow the whole course of the river, and thought that the lower part of it became the Congo

He returned to England to equip and rest, and in 1805 set forth once more upon his quest By the time he reached the Niger most of his party were sick or dead, but still he carried on He started down the river, to follow it to its mouth but in the Bussa rapids he lost his life, Thus died a very gallant and determined explorer The problem of the mouth of the Niger was not solved till twenty-five years later, by two brothers John and Richard Lander

The men who thus first blazed the trail into the heart of Africa were heroes indeed Only the most dauntless courage, only the most iron strength could hope to survive the dangers and hardships Most of them died of fever, or were murdered by natives, but others were always ready to carry on the work Africa is an exacting mistress She breaks, tortures and kills the many who love her, but they love her still, and those who escape her deadly embrace the first time cannot resist her call, and go back

Greatest of all explorers was David Livingstone like Park, a Scot, and also trained as a doctor It was in 1841 that he landed at Algoa Bay For the next thirty years he devoted himself to the conti

nent, neglecting his home, his friends, even his family, all in the cause he had so much at heart, the exploration of Africa and the welfare of the natives He had the rare gift of friendship with them That gave him success and in return he, more than any other man, contributed to their release from the two curses of Africa, slavery and cannibalism

He began by cutting himself off from Europeans, to learn the language and customs of the tribes with whom he was going to work as a missionary In 1849 he started into the interior and had the gratification of being the first European to see Lake Ngami

Two years later he went on another two hundred miles, and made friends with Sebituane, the victorious king of the Makololo Thanks to the king's support, Livingstone was able to discover the Zambezi Then, as the Boers were determined to keep the country closed, he was determined to open it up so he made it his life's work He went down to Cape Town, sent his wife and family back to England, and returned to the north

When he reached the country of the Makololo again, his friend the king was dead, but his son and successor, Sekeletu, received him well, and gave him a party of men to escort and help him With them, he made his way right across towards the north-west and came out on the Atlantic coast at Loanda, the pleasant capital of Portuguese Angola, and one of the oldest European towns in tropical Africa Most of the way he had ridden upon an ox, the famous Sindbad The explorer had no love for him, for the brute was both uncomfortable and stubborn Riding Sindbad he wrote, was little better than walk-

ing, the dullest of all methods of travel Tha journey to the sea and back to Sekeletu took hir two years

Then he started on a journey to the east, as h wanted to find the way to the Indian Ocea Sekeletu gave him a supply of elephant tusks whic he could sell for funds for his work On this journe he heard the Makololo talk about 'The Smok that Thunders", and he found it He came to spot where the great river Zambezi, nearly a mile across, suddenly leaps clear a sheer 400 feet into crack in the earth only 20 yards wide From th crash of the waters the spray is flung up to such height that it can be seen full seven miles awa where, too, the thunder can be heard Deeply impressed by this tremendous sight, Livingston wrote 'It had never been seen before by Europea eyes, but scenes so lovely must have been gaze upon by angls in their flight' He called thes wondrous falls after his great Queen Victoria, bu after him other Englishmen came and built a tow there, which they called in his honour, Livingstone The Victoria Falls are in truth one of the greatest marvels of creation They cannot be shown in one picture alone, nor can all their wonder be seen in a single day

In April 1868 Livingstone set forth once more into the wilderness, and in August discovered Lake Nyasa All around he saw grisly traces of the Arab slave trade, and his terrified porters began to desert His party was much reduced and the Arabs were hostile, knowing that he was the enemy of that dread ful commerce Livingstone was no longer young and vigorous For a quarter of a century he had been



The Victoria Falls from the air. The cantilever bridge carries a railway and motor road and links South Africa with Rhodesia

living in the wilds exposure and hardship were beginning to tell upon him fever and dysentery were sapping even his iron constitution In January 1867 one of his porters deserted with his medicine chest. The loss was desperate He wrote that he felt as though he had received sentence of death But even that would not deter him He knew the risks he was facing, but a man who fears risks can never be an explorer

When, racked by rheumatic fever, he met some Arab traders, he travelled with them, finding Lake Mweru and then Lake Bangweulo, where only four boys remained faithful to him Then pneumonia attacked him He met with kindness and hospitality at the hands of the greatest of the slave traders Mohammed Bogharib Within four months he was on the road again

This time he set out to solve the problem of the river Lualaba, which ran northwards from Lake Bangweulo Could it be the origin of the Nile? His feet developed festering ulcers and he could hardly crawl, so he joined the caravan of another kind-hearted slave-dealer, Dugumbe for he was unable to travel alone Unfortunately, this man's followers quarrelled with the natives and a massacre followed The outrage was so revolting that Livingstone would not stay He crawled to Ujiji, where, his health shattered, he could do nothing but sit and wait. Stores sent up from Zanzibar never reached him The position seemed hopeless

Suddenly one morning his servant Susi came dashing in

'An Englishman is coming!'

It was Stanley, sent by an American newspaper

proprietor to look for the great traveller, who was believed to be lost Stanley's story of the meeting is famous He felt uncomfortable, not knowing how the great man would receive him 'I walked up to him, took off my hat and said, "Dr Livingstone, I presume?"'

'"Yes," said he with a kind smile, lifting his cap slightly I replace my hat on my head, and he puts on his cap, and we both grasp hands, and then I say aloud

'"I thank God, Doctor, I have been permitteed to see you"'

'He answered, "I feel thankful that I am here to welcome you"'

The two explored Lake Tanganyika together, and found that it could not be the source of the Nile Then Stanley left him, for Livingstone, who would not look upon himself as lost, refused to return to England while his work was incomplete

But now he was a broken man, exhausted by dysentery and internal bleeding He reached the village of a chief named Chitamba in Illala, near Bangweulo, where on April 29th, 1873, he collapsed The next morning his devoted servants, Susi and Chumah, came into his tent and found him kneeling by his bedside, dead

Thus passed, as he himself would have wished, the greatest of all African explorers perhaps the greatest explorer of all time Of him Stanley wrote that he stood pre-eminent above all, and Sir Percy Sykes, himself a famous traveller, describes him as a model to explorers and an inspiration to mankind. So great was the reverence inspired by the Great Master as his men called him, that Susi and

Chumah then did a very wonderful thing These two simple Africans felt that he should be buried among his own people, so they took out his heart, buried it on the spot where he died, made a list of all the things he left, embalmed the body, and set out for Zanzibar, a journey of some fifteen hundred miles through warring tribes They refused to deliver their precious burden to a British officer leading an expedition come too late to rescue him, and carried him to the coast Thus did these untutored men achieve the great duty they took upon themselves, for now their Great Master rests, thanks to their devotion, among England s other heroes in Westminster Abbey in London

The next great name in the annals of African travel is that of Richard Burton That remarkable Englishman began his career in India, where he learnt many languages, including Persian and Arabic Brave as a lion, if not reckless, he had in 1954 performed the *haj* or pilgrimage to Mecca disguised as a Mohammedan A year later he faced another wild adventure The Emir of Harar chief of the warlike Moslem Gallas, had forbidden Christians to enter his city under pain of death, because it had been prophesied that the first to do so would be the fated instrument of the downfall of the city Several Christians had thus been done to death The Emir too, had quarrelled with the ruler of Zeila, on the Somali coast who was friendly to Burton To make things worse, small-pox was raging in Harar, and the Gallas would let no one either in or out

Difficulties stimulated Burton to action He decided to go in, and went ' It was a paltry prize, he wrote afterwards, a dull grey pile of stones,

hardly worth the risk of the lives of himself and his two servants They advanced to the gate, sent salaams to the Emir, and prayed for an audience Until that moment every Christian who had tried to enter Harar had at once been murdered But Burton was admitted

'I walked into a vast hall,' he wrote, 'between two long rows of Galla spearmen They were large, half naked savages, each man holding a huge spear I purposely sauntered down them coolly with a swagger, with my eyes fixed upon their dangerous-looking faces I had a six-shooter concealed in my waist-belt and determined, at the first show of excitement, to run up to the Emir and put it to his head '

It was a desperately critical moment, and the lives of the little party hung upon the caprice of this wayward and ignorant fanatic. He graciously held out a skinny hand Burton's life was saved because the Emir earnestly wanted a European doctor And so it was that within a few years there were European consuls in the forbidden city, which to-day is part of the Empire of Italy

So Burton returned alive Two years later, accompanied by Captain Speke he began to explore East Africa, to seek the source of the Nile After surmounting countless dangers from bandits from warring tribes, and from much sickness, on February 13th, 1858, Burton and Speke together gazed upon the waters of Lake Tanganyika Burton was now too ill to go on, so Speke continued alone, and on August 3rd found the second largest inland sea in the world, which he named Lake Victoria

Speke hurried back to London and returned to

East Africa in October 1860, determined to discover the source of the Nile, which still baffled geographers. On this journey he was the first European to enter Uganda, where he was well received by the king Mutesa, whose mother was struck by Speke's magnificent beard and his skill at shooting rhinoceros and flying birds He marched on northwards, and on July 28th, 1862, came upon a gorge, where a river tumbled and crashed among the rocks Here he stood and watched thousands of fish leaping at the falls with all their might, hippopotami and crocodiles lying sleepily in the water of the lake above. He named the cascade Ripon Falls after the then President of the Royal Geographical Society of London, who had supported his expedition Thus the Nile flows from Lake Victoria

The last of the romantic explorers of Africa was H M. Stanley After leaving Livingstone he surveyed the region of the newly discovered lakes, to which he added yet another, Lake Edward Then he made his way down the Conga, arriving safely at Boma in August 1873 One more great journey he made, from the Atlantic side, fighting his way up the Congo through warlike tribes and cannibals, to relieve a German official in the Egyptian service, Emin Pasha, who had been cut off from Egypt when the Dervishes took Khartoum It was on his last journey that Stanley made perhaps his greatest discovery One morning one of his servants called him to look at a big mountain near them, all covered with salt He looked, and saw a cloud of silver, and as he gazed he realized that it was not salt but snow, on the Equator It was the most mysterious mountain



The Ruwenzori Range

Note the file of bearers belonging to an expedition

in the world, no less than the Mountain of the Moon, of which Ptolemy wrote in the year A.D. 150, saying that from it rose the Nile. Speke had heard the Arabs talk of it and the natives knew it, calling it Ruwenzori. It is usually clad in fog and cloud, so that Sir Samuel Baker, who had travelled and shot near it, passed by without seeing it, and Emin had not known it was there. Stanley found that the snows of Ruwenzori help to supply the waters of Lakes Edward and Albert, which is one of the two sources of the White Nile, the other being Victoria Nyanza. Ptolemy was right.

Since Stanley's day Africa has been divided

among the European powers and frontiers have marked out Railways have been built from end to end, and motor lorries have replaced the heads of porters, while mails are carried by aeroplane This is the result of fifty years' work by skilful and devoted men

Within that period one name stands out that will be remembered for ever when men talk of Africa. Cecil Rhodes, a young undergraduate who went out to Africa for his health, grew into a far-seeing statesman, whose labours added two great territories to the British Empire, which have been named after him, Southern and Northern Rhodesia. There, where within the memory of living man was only the warfare of Lobengula, king of the Matabele, savagery and barbarism, there is to-day law, order and civilization It Europe has wronged Africa in the past, her missionaries, headed by Livingstone, and the best type of British officer, have abolished slavery and cannibalism, and introduced education and justice, while the African knows a security he had never dreamt of In the words of Sir Percy Sykes, 'We have sinned but repented, and, thanks to our great explorers and administrators, we have atoned for our sins '

Asia

While the heart of Africa was being explored by British travellers and the frozen wastes of the far north and south were being mapped by the sailors of many nations, there was one vast region which had been civilized for centuries while Europe herself was still barbarous That was Asia But while the coasts had been in touch with Europe since the Middle Ages the immense interior had been shut off slumbering as it were, suspicious of strangers Only vague and fearful tales sometimes trickled through to the outside world

Russia was the first western country to knock upon the door, and both her scientific men and her soldiers insisted on seeing and studying the country In 1857 one of the first of the Russians, P P Semenov explored the range of the Tian Shan, which shuts off the old Chinese Empire from the plains of the north He was a man of science, who did not thirst for conquest, but for knowledge On the other side in the south and west, it was the military authorities who took action Russia was then ambitious to expand eastwards and absorb the independent principalities of Central Asia which under their own Khans and Emirs were protected by the vast waterless deserts, which act as a buffer between east and west In 1842 a British mission from India, consisting of Colonel Stoddard and Captain Conolly arrived at Bukhara to open diplomatic relations but the Emir Nasrullah flung them both into a pit where they were tortured for several

months by huge bugs kept for the purpose, and ther pulled them out and cut off their heads in the marke place In 1862 a famous orientalist, Arminiu Vambery, penetrated into this hot bed disguised a a dervish, and left a description of that monster o cruelty the Emir, who was said by his own people to have been suckled by a tiger

A clever Russian soldier, General Chernaieff, found that the Tartars and Turcoman horsemen, who live on the edge of the desert and constantly cross it, defeat thirst by carrying curdled milk in their *tursuks*, or leather bottles, to which they add water when they find it The acid of the sour milk is very refreshing and quenches the thirst far better than water alone General Chernaieff felt that the native princes had been protected by their deserts for so long that they would have forgotten how to fight, however brave their soldiers might be, and that his men would have better rifles and guns So he decided not to take a big army, which would be difficult to provide with water, but a small, very efficient force of only fifteen hundred men He arranged to provide these with the sour milk, made a dash across the desert in 1864 and conquered the rich provinces of Kokand (Ferghana) with Tashkend

For adding so rich a province to his master's empire, General Chernaieff expected a great reward, but when he returned to Russia he was charged with a heavy debt for the costs of the campaign He was a poor man with but little property, but a bill of sale was taken out even upon that. Fortunately, the papers came before the Tsar, Alexander II He was very angry and wrote the word 'Shameful' across them, and forbade it



Climbing over the Roof of the World—Karakoram
Note the Yak, used for carrying goods etc

In 1867 another Russian commander, General Kaufmann conquered the rich emirate of Bukhara, with the ancient city of Samarcand, once the capital of the great conqueror Tamerlane, as Timur Leng Lame Timur is generally called in English He won great fame for this and the scientific Russian traveller Fedtchenko who crossed the Alai range in 1871 named its highest peak in his honour In 1873 General Kaufmann also conquered the emirate of Khiva Russia did not annex these states but allowed the Emirs and Khans to manage their own affairs as vassal princes under the Tsar The ancient town of Khojand had been won by European troops once before more than two thousand years ago when Alexander the Great seized it

He called it Eskhate, which in Greek mean Farthest

There was yet a people which kept its liberty in the plains the Turcomans, who inspired dread by their raids upon the towns within their reach They are splendid horsemen but wild, and in those days were great robbers In 1881 General Skobeleff broke their power at Geok Tepe, on the east side of the Caspian, and a little later another group of Turcomans surrendered at Merv In ways like that, all Central Asia, west of China, became Russian

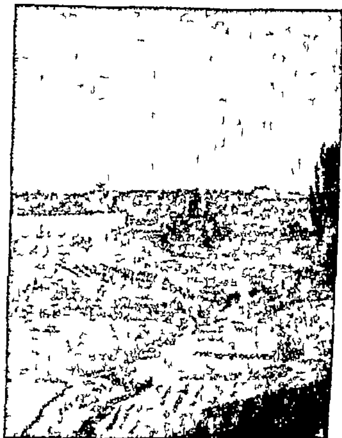
This progress of the Russian Bear in Asia made the British Lion uneasy. There still remained a vast country that was interesting to both English and Russian, hidden and mysterious behind the rampart of the enormous mountain ranges which encircle Chinese Turkestan

No European had stood upon that frontier on the heights of the Pamirs for nearly seven hundred years since the great Venetian traveller, Marco Polo, had been there in 1272 In 1838 an English officer in the Indian navy, Lieutenant Wood, reached the spot and looked down upon the mighty Amu Daria trickling out of a frozen lake, the Sir-i-Kul That great river is famous in classical literature as the Oxus

All that great unknown world was very tempting to men of science as well as soldiers In 1857 two Germans in the service of the Indian Government, Hermann and Robert, Schlagintweit, succeeded in crossing the Karakoram, which means the Black Gravel, a great plateau 18 000 feet above the sea, which really does seem to be the Roof of the World Up there in that thin air and fearful cold, both men and beasts suffer terribly from mountain sickness.

The head aches, the lips swell and burst, the mouth tastes of corruption, the heart thumps, the lungs gasp Of the beasts of burden, many die in suffering and the road is marked by the skeletons of horses The two Germans returned, but a third brother, Adolf crossed and succeeded in reaching the city of Kashgar Now Kashgar belonged to China but at that time an Usbeg by name Yakub Bek had made himself prince Yakub was a remarkable character He had begun life as a dancing boy in a tea-house in Tashkand become a prominent soldier, and by craft and treachery made himself master of Kashgar and of the greater part of Chinese Turkestan He assumed the title of Emir Muhammad Yakub Khan, Emir-ul-Musulman, Chief of the True Believers and Atalyk, that is Defender of the Faith

The appearance of a new and powerful Mohammedan chieftain in Central Asia excited attention at once in Saint Petersburg, London and Calcutta Perhaps he might be a useful friend, or perhaps a dangerous enemy But Yakub was ruthless and cruel He feared strangers, and Adolf was at once murdered In 1868 an English officer named Hayward also crossed the Karakoram and reached Kashgar He was lucky, for he came out alive, but he was shortly afterwards murdered on the Karakoram His murderer was unknown and the place remote, but an Indian detective took up the trail and, after many years' patient hunt, ran his man down He found him in a bazaar in Tashkand in Russian territory At the demand of the British Government the Russian authorities handed the murderer over, and he was punished



The Approach to Kashgar

for his crime

About that time there was living in Leh, Western Tibet, an Englishman named Rob Shaw Traders used to come into Leh from ma directions, and among them Shaw met an agent Yakub Khan, who invited him to visit his mast in Kashgar Shaw accepted. He was well recei ed by the Khan, who said he would be glad receive an official mission from the British Yaki

was crafty, for he saw that such a mission would add to his dignity and prestige

So in 1870 the Indian Government sent F D Forsyth to see Yakub, and three years later Forsyth went again, this time taking a well organized expedition The object was to make a trade agreement with Yakub, but the needs of science were not forgotten Three scientific men went with Forsyth, but the geologist, Dr Stoliczka, could not stand the strain of that awful journey across the Karakoram and died of mountain sickness on his way back to India The work of the Mission, both difficult and dangerous, was greatly helped by some Indian Pandits, who had been doing important surveying work in Tibet It is amusing to read that Yakub had issued a very original law, that every visitor to his country who came without a wife was allowed three days in which to find one or leave the country As the members of the Forsyth Mission ranked as diplomats, they were probably excused from this obligation

A man who revealed two of the secrets of the heart of Asia was another Russian, N. M. Prjewalski, who spent the greater part of his life exploring the depth of inner China the cruel Gobi desert, the swamps of Tsaidam, the shifting waters of the late Lob Nor, the Golden Mountains, Altyn Dagh, the Mountains of Heaven, Nan Shan and Tian Shan, and Tibet Until his travels it was believed that no such animals existed as wild horses and wild camels, for they were known only as the servants of man But Prjewalski found real wild horses in Mongolia and real wild camels too In 1888 this great traveller died of typhoid on the shores of Lake Issyk Kul

The great names mentioned are of men who explored the present There went up also from India a man who explored the past The work done by Sir Aurel Stein was extraordinary He revealed a world forgotten, yet preserved in small and often trivial detail by the hot, dry sand of the Takla Makan, where he unearthed city after city He found even sheaves of corn with mummified mice and even the traps that had been set to catch them, he found rubbish heaps as fresh as though recent, dating back well over a thousand years, yet in some cases keeping even the smell This was worst, he wrote, in a pile of nine feet of rubbish in an old Tibetan fort of the eighth century Inside the fort, he writes the smell was horrid so for relief he went outside at intervals But outside the blizzard *was so piercing that for shelter he went back to his ancient smell* He found masses of old documents title-deeds, records police orders, passports and accounts all written, not on paper, but on wood He discovered new languages and re-discovered old ones He found remains of ancient art, many beautiful things Least expected was the strong influence of the Greek classics upon ancient Chinese art, greater than both the Iranian and *Indian art* through which it acted cherubim, with wide open eyes, with nothing of the slant of eastern Asia, *shading, otherwise not known in Asiatic art*, or the frank enjoyment of the good things of life decanters, goblets, guitars with boys and girls with *faces like the Greeks and head-dresses from Iran*

Most extraordinary of all, in the oasis of T Huang he found a cave that had been sealed in the beginning of the eleventh century, at the time of

the invasions of the Tanguts, to preserve the treasures of the old Chinese temples This room he called the Hall of the Thousand Buddhas, and it is difficult to imagine his sensation when the secret was revealed to his eyes He found over six thousand documents in numerous languages, pictures from the best period of Chinese art, and a piece of the oldest known Chinese textile



A Mongol cowboy of the Gobi desert. He uses the lasso-pole in his hand for catching wild horses.

From the heart of Central Asia he brought back documents in the Kharoshthi language far older than any preserved in India, which show that in the second century of our era Indian influence extended to the very borders of China proper He found old Brahmi script containing three languages, one being the oldest known manuscript in Sanskrit. He found too the oldest known Tibetan manuscript dealing with worldly affairs He found the best relics yet known of the ancient, half-forgotten Turki literature He found and surveyed for two hundred miles the ancient frontier wall of China, built to keep out the hordes of barbarians more than a thousand years ago, yet in that extraordinary climate keeping astonishing details

preserved, even movement orders of troops and money spilt twelve centuries ago out of a hole in a sack carrying the pay for the soldiers Stein deserves to rank with the really great explorers Most of his work was done in blizzards with forty degrees of frost To him a broken leg was only a provoking delay in his work of survey at 24,000 feet above the sea

Among the explorers of Central Asia much of the credit must go to Indian Pandits, who did specially fine work in Tibet One of the greatest of these was Nain Singh, the Pandit of Kumaon, who found the gold mines of the Tibetans at an altitude of over 16,000 feet These mines were very jealously guarded by the Tibetans, who frightened the natives away by telling them that the gold was protected by evil spirits But he found that the best protection was the difficulty of the journey and the fearful climate at that great height Another great Indian was Kishen Singh, who made his way into the then forbidden city of Lhasa and back Sir Percy Sykes, in his *History of Exploration*, tells the story of a Chinese lama who was trained and sent to Lhasa, to find out whether the great river Brahmaputra was the same as that river which in Tibet is called the Tsang-po He had orders to follow it as far as possible, and then throw into it a number of logs in which certain signs had been cut The idea was that these logs would eventually drift down and be picked up a thousand miles or more farther down If one log were found, it would prove that the Tsang-po of Tibet is the upper portion of the Brahmaputra Watch was kept on the lower river for two years and then given up

Four years later the Indian Kinthu, who had

been in the service of the lama, arrived back in India He told a wild and romantic story, how the Chinaman had failed in his trust, how he himself had been sold into slavery, how he had worked for his freedom, and then made his way down the Tsang-po to carry out the work which had been entrusted to his false master He described in detail all the places which he had passed down that great river, right down to a point within sixty miles of the plains of India Then, he said, as he could not go any farther, he had thrown the logs into the water He was not believed at first, but thirty years later his story was proved to be true, and at long last he received the reward which he had so well deserved Sir Percy Sykes, himself a great traveller, pays a generous tribute to the courage, capacity and enthusiasm of the Indian surveyors, with whom he worked for many years

One more great Indian adventure must be mentioned, a recent one On the frontiers of India and Tibet stands the loftiest mountain in the world. Mt Everest, rearing its head to 29 002 feet, has lured the boldest spirits to dare its dangers Time and time again have men tried In 1924 two Englishmen, Mallory and Irvine, and many gallant native porters, gave their lives in the attempt to reach the summit In 1933 a very determined but unsuccessful effort was made under Hugh Ruttledge. Mountain technique is not afraid of it. To reach 28,000 feet is almost easy Ruttledge maintains that, if only the weather be favourable, the conquest is certain

But if the great mountain has not been scaled it has yielded to the aeroplane On April 3rd 1933,

Lord Clydesdale, Colonel Blacker and Flight Lieutenant M'Intyre flew across the top The eye of man had not before looked upon the mountain's southern face, and the photographs taken on the wonderful flight show where Irvine and Mallory now rest, the grandest tombstone man ever had

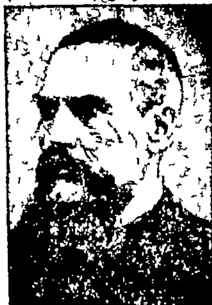
Arabia

FEW parts of the world have remained so unchanged and mysterious as Arabia Few lands have lured the adventurous so enticingly

The *hajj*, the great pilgrimage of the Mohammedans to Mecca, for centuries excited the curiosity of Europeans, but for an unbelieving Christian to venture his head there meant certain death. In 1812 a Swiss dared it, J L Burckhardt For two years he had lived among Arabs in Syria and studied the language and the Koran to such good effect that he could pass for an Arab doctor So calling himself the Sheikh Ibrahim ibn Abdullah, and disguised as a pilgrim, he went What is more, he was successful, for he came out alive and wrote in English the first description of the ceremonies and of the Ka'ba, that mysterious black stone which, like other meteorites, fell from the heavens

In 1854 an Englishman undertook the great adventure, that dare-devil Richard Burton, to whom no land was closed He, too, penetrated disguised as a doctor learned in the law, and so became the Haji Abdullah He performed all that the ritual demands, and when it was finished, he withdrew to

Jeddah to take ship home The nerve strain must have been very great, for the slightest slip on his part would have meant instant death There must have been some fifty or sixty thousand pilgrims from all parts of Africa and the east, without any notion of hygiene Especially in that great heat, with so miserable a water-supply, it must have been a fearful centre of infection There was no provision for proper cleanliness, the air must have reeked with the putrefying offal and flesh drying in the sun, and sanitation did not exist



Richard Burton
1821—1890

Burton confessed that, when he had entered once more upon the open road and drank in the pure air of the desert which he had learnt to love, the newly-made Haji Abdullah felt 'such joy as only the captive delivered from his dungeon can experience'

His relief was justified for it had been a narrow escape His servant Mahommed, a native of Mecca behaved very strangely, and tried to extort money from him Something Burton had done or said had roused the boy's suspicions, and to a fellow servant he had said that he was sure his master was a sahib from India, and added he

hath laughed at our beards' The boy had judged truly, for it was as a British officer in India that Burton had first learnt his Arabic, and studied the Koran and the philosophy of the East

Many great travellers have penetrated into the depths of Arabia since the days of Burton, every one has met with great adventure, and everyone has been able to do so only because he could speak the language Even women dared it, though in some ways travel is easier for a woman than a man In 1913, Gertrude Bell, on the journey from Damascus to Hail, was shabbily treated by a sheikh of Najud, who took her revolver and field glasses, and then she was held prisoner by the Shammar tribe in a place which, she wrote 'smelt of blood'

But the greatest adventure of all that ever befell a European in Arabia was that of an eccentric *young English archaeologist and scholar*, T E Lawrence

During the Great War 1914-18, some British officers went to the Hedjaz to persuade the Arabs to rise and throw off their masters the Turks Among them was this youth, who knew the Arabs well and could speak their tongue, which he had learnt when working as an archaeologist in Syria, studying the ancient castles of the Crusaders Lawrence landed at Jeddah on October 16th 1916, and for the next two years lived as an Arab and fought as a soldier The Arabs learnt to like him, then to respect him, and then to love him The young Englishman could ride a camel as well as any Arab could endure the heat and thirst in the desert as well and as long as any Arab Whatever they could do, that he could do as well, and sometimes

better He was no longer surveying ancient castles, but raiding Turkish outposts, blowing up Turkish military trains, and fighting Turkish armies The student and the book-lover had read much of ancient wars, and he saw what are the eternal rules of warfare He made use of that reading and, with his splendid brain, applied it to the task he now had in hand, and in the end victory was his Two years after his landing at Jeddah, almost to a day, with his Arab officers and friends, he entered the ancient city of Damascus, now once again an Arab town

Once, when exploring enemy land, he was taken prisoner by the Turks The ordeal through which he was put was unspeakable, and he was flogged into senselessness Yet, bleeding and lacerated, he crawled out of the hospital where they had flung him, and crept away A wandering tribesman took pity on him, mounted him on his own camel and restored him to his friends At the very end he was made prisoner by his own people, a patrol of the Bengal Lancers They would not believe that he was English, and prodded him with a lance He was not released until they met an officer

Through those two years in the desert Lawrence had dressed like an Arab, but had shaved regularly His beardless face, generally fair but now burnt red by the sun, and his bright blue eyes must have been in startling contrast with his white robes and head-dress There was no one else like him in all Arabia, and once seen, he was instantly known Among his own Arabs, that was his greatest protection.

The Great War threw open much of hidden Arabia to the foreign eye, and to-day the Infidel

may visit even the Holy City of Mecca upon payment of a fee Yet the final mysteries of the land have only recently been revealed The last corner of this stubborn land to yield to the intruder has been the *Rub' al Khali*, the Empty Quarter, the lifeless, desert of sand, where over vast distances neither man nor beast nor plant can live This huge area is protected by its waterlessness, but even more by the fanatical hostility of the few wandering tribesmen. These violently resent the lifting of the last curtain, and are prepared at all costs to defend the few brackish waterholes and scanty grazing ground that do exist here and there in that area of some 300 000 square miles Two Englishmen conquered it at last; Philby and Bertram Thomas Philby had entered the service of King Ibn Saud, and Thomas had acted as Vizier to the Sultan of Muskat' Both were masters of the dialects and customs of the people Philby had accepted Islam, but Thomas was a Christian



Lawrence

It was in 1928 that Thomas undertook his first journey, secretly This was a reconnaisance, on

which he was helped by the Kathir tribe, who escorted him to a range of watered hills, the Qara, the region from which came the sweet-smelling frankincense the same as that burned by the Hebrews in the tabernacle in the days of Moses and mentioned in the Song of Solomon in the Bible It was on December 1st, 1930, that Thomas started a second time, having bought the support of a local sheikh by promise of a rich reward Carefully avoiding the tribesmen, who would be sure to murder the rash Kafir or Unbeliever who ventured into their domain, Thomas reached the Persian Gulf on February 5th, 1931 Thus he had crossed it from south to north

Philby was an experienced Arabian traveller On a journey to see the Ruler of Jauf some years previously, through unsettled country, he had reached Jauf and made friends with the slave governor Philby described his friend as one of the most attractive personalities he had ever met in Arab lands He refused a cash present, but was anxious to be provided with a good poison

Well qualified by local knowledge, backed by the power of King Ibn Saud himself Philby crossed the Empty Corner from east to west in 1936 Even then he was exposed to desperate hardship On one vast waterless expanse the camels broke down For six days they had marched in long stages 'Never had I seen Arabs drive camels as they drove that day, from two in the morning till nine at night Never have I seen camels on the borderland of starvation march as those camels marched ' They came through In ninety days the *Rub' al Khali* had been crossed for the first time from east to

west This was described by Sir Percy Sykes as a magnificent achievement

By those two journeys, wrote Sir Percy, the ve that hid the *Rub' al Khali* has been rent, and th word 'End' has been written on land exploratio in the old sense of the word, for the last of th great unknown areas of the inhabited globe ha now been conquered And we may all, surely, be glad to think that this great effort was made no with modern inventions, not with motors or aero planes, but with the age-old method, on the legs o camels and alone



Australia

AUSTRALIA is a world by itself, a fragment of an ancient past First discovered by a Hollander William Janszoon, in 1606, it was long known as New Holland, but it was many years before any serious attempt was made to examine it, although another Hollander, Abel Tasman, a great navigator had discovered the adjoining island called after him Tasmania.

But in 1770 there landed on the south-east coast a Yorkshireman who was perhaps the greatest navi gator of all time, Captain James Cook, accompanied

by a learned man of science, Sir Joseph Banks They were so struck by the wealth of flowers in that secluded spot, that they named it Botany Bay It was here that they noticed an extraordinary animal, 'as big as a greyhound, of a mouse colour, and very swift', which 'went upon only two legs, making vast bounds' That was the first time a European set eyes upon a kangaroo

As was the case in Africa a few settlements grew on favoured spots around the coast, especially in the south-east corner, but the interior long remained a blank Australia never enjoyed the fame and romance of Africa, but produced her share of heroic explorers, who ventured into the unknown interior True, the natives were primitive rather than savage, not yet emereged from the culture of the Stone Age, offering danger rather of occasional murder than of organized warfare, nor were there fierce beasts to fear The greatest foe was thirst, which claimed its toll of the bold travellers who ventured into the stony heart of Australia

The first great name was that of E Stuart, who in 1828-30 explored the rivers called by him Darling, the noble Murray, and the Murrumbudgee which joins it Fourteen years later, as a veteran, he returned to complete the survey of the Darling In 1844 Dr Leichhardt left Moreton Bay on the east coast and vanished into the unknown Fifteen months later, almost naked half dead from hunger this intrepid man staggered on to the north coast of the continent in the Gulf of Carpentaria, which no white man had seen since Janszoon's visit, nearly two and a half centuries before In 1848 he braved the unknown again, and was never heard of since

In 1860 the colonists of Victoria, in the resolved to send an expedition to cross the whol continent from south to north The Parliamen made a grant, and the colonists subscribed a speci fund among themselves, so that the expeditio should be really properly equipped They eve imported camels specially from India, to help the cross the central desert

The two chief members of the party were Rober O'Hara Burke, an officer of police and Willia John Wills, from the Melbourne Observatory The began by establishing a base depot at a place calle Menindee on the river Darling, intending to ad*vance northwards from there Burke left a ma*n named Wright in charge and himself pushed on taking seven men, five horses, and sixteen camels, t find a suitable place for a still more advanced dum farther north, where Wright was to follow by eas stages Burke found good water supply and graz ing land at a place called Cooper's Creek, so ordere Wright to move the depot there

For some reason Wright did not obey orders ac curately but frittered away his time in local investi gation, so Burke decided not to wait any longer fo him at Cooper's Creek, but pushed on still farther taking Wills and two other men, Gray and King *with a horse and half a dozen camels* for supplies With considerable difficulty, they got past the McKinlay mountains, and reached Flinders River, which flows into the Gulf of Carpentaria, on the north coast of Australia Thus they accomplished their task

They did not wait there long but started back upon the return journey on February 23rd, 1861

Not long after this Gray fell ill, and on April 16th he died Five days after burying their comrade, Burke, Wills and King crossed the desert again and reached Cooper's Creek, where they looked for rest and fresh supplies But they were cruelly undeceived The man they had left in charge thought they would never return He had abandoned hope, and his post too, on that very day Wright had not even sent out a search party Their position was desperate Worn by their long trek to the north and back, they were hardly fit to trudge their way to Menindee They wandered about the district for some time in search of food, or else tried to make the road to Adelaide but they were too far gone Some wandering natives helped them, but before very long both Burke and Wills died of starvation King alone survived

As time went by and no news of the expedition was forthcoming the promoters sent out relief parties to find and help them Two of these reached the north coast, while a third explored the middle of the continent The fouth, led by M A W Wowitt, found King still alive, and brought him back to safety He told them where his comrades lay, so the bodies of Burke and Wills were brought back in sad procession to Melbourne, and given a solemn public funeral and a monument was erected that their names might be held in honoured memory

Heights

EXPLORERS have faced terrors innumerable, deatl and suffering, in order to examine the face of th earth There are also the heights of the air and th depths of the sea, and of the earth

Balloonists and men flying in aeroplanes hac learnt a great deal about the atmosphere, up t quite big heights An Italian in May 1937 reachec a height of 51,361 feet in an aeroplane The ai which envelops our earth has not a sharply-definec surface like the sea, but gradually becomes thinne and thinner, as everyone knows who has climbed a mountain The first few thousand feet are subjec to clouds, rain, mist, fog, and storms But these do not extend beyond six miles up from the earth That part is called the troposphere. Beyond that is a region of perpetual calm, of unbroken sunshine anc unvarying fine weather without wind or moisture That is called the stratosphere The air up there is so thin that a human cannot breathe in it, anc cold like a Siberian winter It is cold in spite o the sunshine, because there is nothing for the sur to warm

A Swiss professor in Brussels, August Piccard, determined to expore this stratosphere He wanted to find out all sorts of scientific details about the temperature and density of the air, and above all, certain mysterious rays that seem to come to us from outer space and are very little understood to which have been given the name of cosmic rays

It was a very brave thing to do, for nothing like it had ever been attempted before A long time was spent making the preparations and working out all the calculations upon which they were based It is almost impossible for men to breathe near the top of Mt Everest, and out of the question at twice that height Professor Piccard therefore was obliged to take his air with him What he did was to make a strong ball-shaped chamber of aluminium, the lightest metal, and an enormous balloon filled with hydrogen, the lightest gas, to lift The ball was to be air-tight and oxygen for breathing supplied inside from cylinders The ball had windows and holes through which to thrust the ends of his instruments, all carefully designed so as to be air-tight He could not afford to lose any of his precious oxygen

At last everything was ready On May 27th 1931, on a perfect morning, his balloon went up from the flying ground at Augsburg, a spot chosen far from the sea to avoid the danger of coming down into the water The two brave men, Professor Piccard and his assistant M Paul Kipfer, allowed themselves to be screwed in, and they were high in the air before they knew they were off, so smooth was the motion

Disaster threatened them almost at once When the Professor tried to push an observation instrument through the valve in the floor, he found that the metal had warped slightly, so the instrument did not fit the hole An ominous hissing showed that their precious air was escaping Desperately they struggled The sun beat down on the The situation was terribly threatening, the

inside rose to 104° F, and the two men were nearly stifled They were already 20 000 feet up and still rising. Piccard then decided to let out some hydrogen, to prevent their rising higher, but the valve jammed. They were rising rapidly, with no means of stopping, and the air was whistling out through the hole in the floor They seemed doomed

Then at last, by a desperate effort, the *Professor* forced the instrument out, the hole was plugged and they were saved

Then another danger threatened them The heat of the sun made the rubber seats of the manhole covers shrivel and wrinkle Once more the air began to escape

Thus they drifted slowly, about ten miles above the earth They looked out through the windows The sky was beautiful of a bluish purple not quite dark enough to see the stars The Alps below them looked like a relief map From that height if there had been no mist over the earth they could have looked upon a circle seventeen hundred miles in circumference.

Then at last, as the sun went down the gas in the balloon began to contract, and they slowly sank. At nine at night when a mere two and a half miles up, they opened the window, and how glad those two brave men must have been to drink in the fresh air once more

The balloon subsided gently on to a glacier near Innsbruck in Austria, about a hundred miles from their starting place Worn out and hungry, the two slept till morning, and then walked down to the nearest village, Ober-Gurgl, where their



The American stratosphere balloon before its record ascent of
?4,000 feet above Dakota

arrival caused an immense sensation Devoted a they were to their scientific work, we can have little doubt that the thing that interested them most at that hour was a good solid breakfast, after twenty four hours' starvation They had been up to 53,152 feet, just over ten miles

The example set by Piccard stimulated others into this new field On January 31st 1934, a party of Russians, after two years upon their preparations, went up in a balloon called the *Osoaviakim* They reached a greater height than Piccard, 72,17 feet, almost thirteen miles, but as they came down a hurricane wrenched the gondola from the balloon and it crashed All the scientific instruments were smashed to pieces, and the bodies, still in the gondola, were mutilated beyond all description

Undaunted by this tragedy, two Americans went up in Dakota on November 12th, 1935 They landed safely not far away They said that up there the sky was like a jet black awning, and the cosmic rays one hundred and fifty times as intense as upon the earth And they had beaten the record They had been up to 74,000 feet, that is almost fourteen miles up into and above the air

Depths

THE dangers and mysteries of the sea have inspired men of all kinds, but few have been invited by the depths The greatest to which a driver can go is some 300 feet below the surface Few men can stand the immense pressure of the water at that depth, even in their special suits of armour, and there is little they can do when they get there I

was gold that tempted men to break that record, and in 1929 and 1930 some brave Italians were enticed down by the lure of £1,000,000, buried in the ship *Egypt* which had sunk off Ushant in 1922 She lay some 400 feet below the surface, but those Italians reached her The divers were enclosed in a kind of steel bottle, to stand the terrific pressure and in it they could scarcely crawl All they could do was to signal and telephone to the men on deck, to guide them with their grab Their pluck and persistence had their reward, as always and the bullion was recovered

Those Italians however, were not men of science An American zoologist, Dr William Beebe, especially interested in fishes, resolved to see what life in the sea was like at far greater depths It was known that down there no light penetrates from the sunshine above, that the pressure is terrific, and no ordinary creatures could survive there an instant Yet it was known that there are fishes down there, weird and strange monsters, that live by devouring one another, and provide their own lights, for they are luminous Sometimes these fishes are brought to the surface by deep trawls but directly they enter into the lower pressure they burst

Beebe employed the same method as Piccard He had a ball of steel made 4 ft 9 in in diameter, strong enough to stand the tremendous pressure Now the pressure of the atmosphere on the surface at sea level is fifteen pounds to the square inch But Beebe was going down, not to the 300 ft of divers but to ten times that depth to 3,000 ft more than half a mile, and down there the pressure is a half a ton to the square inch

The risk, he knew, was very great, so as experiment he sent the thing down empty, to the sealing of the windows, for obviously it wo have been useless to go down unless he could l out He knew that if the shell had given way, window burst in, the men inside would have be not drowned, but *crushed to pulp instantly* S was with breathless interest that they hauled shell up after its trial dive Directly they ope the door on the deck of their vessel, 'without slightest warning the bolt was snatched from th hands and shot across the deck like a shell fron gun' It was followed by a solid cylinder of wat and air mixed with the water, to look like ste Beebe wrote, 'If I had been standing in the way should have been decapitated'

These plucky men sealed themselves in, a went down, down, to see with their own eyes manner of life exists in the grip of such t forces

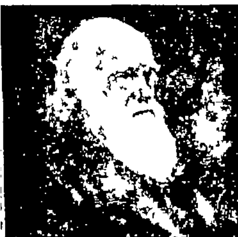
It was all new and strange, for what little informa tion we had was but the 'uncertain markings on the threshold of a new world' When down inky blackness, Beebe switched on the searchlight It cut an almost material swath across the field of vision, and for the first time in the history of scientific inquiry, the life of those depths were revealed to human eyes, as he gazed upon th patterns of fish of unknown type that swam acro the narrow field of vision Between 1930 and 19 he made no fewer than thirty such dives in th clear waters off Bermuda

II

CONQUEST

The Dunce who Taught Men to Think

In the early years of the nineteenth century there lived in the fine old town of Shrewsbury in England a prosperous country doctor named Robert Waring Darwin He was a sound, practical man, successful in his profession, but, although son of a well-known naturalist, Erasmus Darwin, Dr Darwin had no marked taste for science Mrs Darwin was the daughter of Josiah Wedgwood, whose name is famous in the pottery world



Charles Darwin 1809 & ...

To this eminently practical couple there was born on February 12th, 1809 a second son whom they christened Charles The boy showed no great promise as a child but a marked taste for flowers birds and stones He must in fact have been a trouble and disappointment to his parents, for at

Shrewsbury Grammar School he was a failure narrow, old-fashioned curriculum of the Greek Latin classics was to him meaningless and dea dull, and the seven years at school were wast But his spare time was spent in eager interes queer sidelines of knowledge He tried to pick some chemistry, a subject not taught in Eng schools in those days, and was punished by master for wasting his time in such a useless w He was fond of poetry, but above all, he liked things, animals, plants, and also rocks The sp of the naturalist was in him. He was also keen on outdoor sports, on horses, dogs, riding, above all, shooting

His father then sent him to Edinburgh to medicine, so that he would carry on the fan tradition and be a doctor But he found lectures very dull, subjects that should have b interesting were put to him in a boring way, the horrors of the surgical operating theatre bef the days of chloroform shook him so badly that gave up the notion of being a doctor The c good he obtained in Edinburgh was the friends of some naturalists and practice in skinning an stuffing birds, which was taught him by a negr Edinburgh did him no more good than Shrewsbur He picked up a good deal of knowledge but only b the way, and of the stated subjects he learnt nev to nothing

His father, in despair, came to the conclusio that the only place for him was in the Church Charles agreed, and went to Cambridge Universit to qualify Here the old story was repeated H became friendly with Professor Henslow wh

ectured on botany, and took him out for walks in the countryside, and also with the famous professor of geology, Sedgwick, who brought him back to a subject from which the dullness of the teaching in Edinburgh had frightened him He became deeply interested now, read a great deal about many branches of natural history, and devoured good travel books He neglected his stated work, as usual, but managed to take his B.A in 1831

That was to be the critical year of his life His friend Professor Henslow happened to hear that the Admiralty was sending a ship to survey the coasts of South America, and that the commanding officer, Captain Fitzroy, was looking for a young naturalist who would care to go with him The Professor recommended his young friend as a keen man with the makings of a good all-round naturalist To his father's practical mind it was a hare-brained scheme for his son to go gadding about the world instead of staying at home like a respectable person and continuing to read for the Church He was, in fact, seriously shocked at the idea Luckily, when his uncle, the second Josiah Wedgwood, pleaded his cause, his father rather grudgingly relented, and Charles was permitted to sign on as naturalist to H M S *Beagle*

She was not a modern, comfortable craft, but only a 235 ton brig, with no luxuries and hardly any conveniences Not only was there no laboratory or workroom for him, but not even a cabin to himself But Captain Fitzroy took a liking to the keen young naturalist, and gave him the use of half his own cabin

The *Beagle* sailed from Devonport on December

27th, 1831, and the young naturalist must ha suffered much from the cold and from sea-sickne during the first ten days at sea, fighting the gales the Bay of Biscay, before they made Tenerife January 6th

Now for the first time Charles Darwin was real in his element Now he was to feel that wonderf thrill of setting foot on the very shores of which had dreamt For at Cambridge his mind had be fired by the work of that greatest of travellers, v Humboldt and above all, by *his description* Tenerife

But fate was against him at the start for t port authorities at Santa Cruz were afraid of chole and refused to allow anyone from the ship to lan What a cruel disappointment that must have be for young Darwin as he stood on deck and watche the lofty peak of Teyde, over 12,000 feet above th sea, fade gradually away into the clouds !

A day or two later he received his consolatio They reached the Cape Verde Islands and Darw *went ashore on the island of Sao Thiago or S* Iago, and for the first time found himself standin on burnt-up brown volcanic soil almost bare vegetation, utterly foreign from anything he ha seen before

From that day forward, life must have been on long dream of delight, as the naturalist explored th wonders of the coasts of South America. He sa the stately exuberance of the tropical forest a Bahia and was allowed no less than three month at Rio de Janeiro then a miserable fever-stricke city in the midst of surroundings of incomparabl beauty He saw the pampas of the Argentine, with

their queer birds and mammals He saw the *gauchos* catch the rhea, the South American ostrich, with the *bolas*, their special weapon He saw them strip naked and ride their naked horses into the river He was astonished, he wrote, when he saw how splendidly the two animals, man and horse are truly suited to each other He went down to Patagonia, then an almost unknown land, where he found huge bones of a gigantic ground sloth, but recently extinct. This started him thinking on the relation between the extinct and the living, and then between kind and kind, species and species He visited the Falkland Isles where there are no trees at all and hardly any bushes He saw the storm racked fjords of Tierra del Fuego the Land of Fire, with glaciers running down into the sea, and naked savages at the bottom of the human scale He travelled over the peaks of the Andes, up the coast of Chile, and at Valdivia saw the horrors of an earthquake He landed on the Galapagos Islands, out in the Pacific, where he was astonished to find the queerest of creatures, lizards that ate seaweed, birds not frightened of men and monstrous ungainly tortoises

Then their vessel crossed the Pacific, and they landed at some of the beautiful islands of Oceania, and at Sydney and Darwin saw New Zealand He landed on coral islands, crossed to Mauritius rounded the Cape of Good Hope, and so returned home landing in England in October 1836

It was a very different Charles Darwin that then settled at Cambridge The idea of the Church had long since been forgotten Under the stimulus of that wonderful adventure he had ripened He had

seen, observed and, above all, he had learnt to think independently, to observe accurately, to reason logically, and to write clearly, as one biographer has well put it. And that clear thinking of the young man who had been a dunce at school was destined to revolutionize the thoughts of man.

When he had landed at the *Galapagos Islands*, far out in the Pacific Ocean, he had found that each separate island had its own kind of bird, and, what was even stranger, its own kind of tortoise. How did they get there? Why were there so many kinds? Why did each island have its own peculiar set of creatures? All were clearly of the same general type that lives upon the mainland. Those birds must have come originally somehow from the mainland, and then, living an isolated life, developed into different forms. The only thing that could explain the problem was Descent with Modification.

His ideas grew slowly. He evolved his philosophy gradually, but *gave his whole life to it*. *It was* in 1837 that he opened his first notebook to collect facts for the theory that was taking shape in his brain, but it was nineteen years before he wrote it out.

A great change came over him soon after this. As a young man he had been strong and vigorous, an untiring horseman, a fine shot and an athlete. When he was about thirty a mysterious illness attacked him that clouded the rest of his life. He became subject to fits of lethargy, he was easily fatigued, and towards the close of the day would be spiritless and exhausted, his head swam and his hands trembled; gastric trouble ruined his sleep at night. His old love of poetry and music turned to



The wild magnificence of Tierra del Fuego where glaciers run down to the sea

dislike His capacity for work was heavily reduc ed Yet he turned out a prodigious amount work, and lived a full life until he was sevent four thanks to the constant care of his wife, Emm Wedgwood, his cousin, whom he had married in 18

It was in 1856 that he started writing out h theory In 1858 he received a bolt from the blu A field naturalist with whom he had been in corr spondence, by name Alfred Russel Wallace, now work far away in the Moluccas, sent him the man script of a paper he had written as a result of wh he had seen and thought about in the orient forests The paper had the rather ponderous titl 'Essay on the Tendency of Varieties to depart ind finitely from the Original Type' Wallace ask Darwin's opinion on the essay, and requested hi to hand it on to Lyell, the geologist

When Darwin read the paper through his hea must have sunk like a stone His friend had ant cipated him The fruit of nineteen years patie plodding was wasted

He sent the essay on that same day to Lyell wh had already advised him not to postpone too lon the publication of his own work He wrote 'You words have come true with a vengeance that should be forestalled'

Darwin was human, and it is easy to understan how, in the first bitter moment of chagrin, he fel inclined to throw up his work and leave the field t Wallace But Lyell, and his friend Hooker, th botanist, urged him not to and it was on the advice that a combined paper by Wallace and Dar win was read before the Linnean Society in Londo on July 1st, 1858



Not Man's ancestors but relatives

This momentous paper fell flat, probably because only three men understood what it meant Lyell Hooker and Huxley But it marked an epoch

Darwin now set to work in earnest, and in 1859 published what he called 'an abstract' of his meditations and experiments of twenty years Its shortened title was *The Origin of Species* By 1876 sixteen thousand copies had been sold in England and it had been translated into almost every civilized language

It gave rise to tremendous excitement in Eng-

land, because it was looked upon as an attack upon Christian belief The Bible taught that God created Man on the sixth day If Darwin taught that Man was not created on the sixth day, in fact not created at all but descended from monkeys, he must be the enemy of the Church As a matter of fact, Darwin did not think that Man is descended from monkeys What he taught is that Man and monkeys are both descended from one kind of ancestor But the men of the Church did not understand that *In fact, very few people understood Darwin at first*

The Church was up in arms In 1860 there was a meeting of the British Association for the Advancement of Science at Oxford, where the chief men of both sides met in debate Bishop Wilberforce spoke for the Church, He was an excellent ecclesiastic, but of Science his ignorance was complete He had read a little for the occasion, and been supplied with a few points by Professor Owen, who did not like Darwin, but he had learnt a lesson without digesting it, and he wound up his series of blunders with surprising want of taste, in a ponderous attempt to be funny

'I should like to ask Professor Huxley,' he demanded of Darwin's great champion 'is it on his grandfather's or on his grandmother's side that the ape ancestry comes in?'

Huxley rubbed his hand in glee, and turned and whispered to his neighbour to that gentleman's astonishment 'The Lord hath delivered him into my hand,' and then arising, calm and dignified told the Bishop that he like them all, had grown out of a speck of protoplasm no bigger than the tip

of his pencil, and continued

'I should feel no shame to have risen from such an origin, but I should feel it a shame to have sprung from one who prostituted the gifts of culture and eloquence to the service of prejudice and falsehood'

From that date the battle raged fiercely Most of those who attacked the new ideas quite failed to understand them

In the long run the effect of Darwin's work was to make men think as naturalists, to seek the causes of things in nature, not in mystery Men turned to it with relief, to escape from the unbending demands of the intolerant churches, and to devote their efforts to improving the condition of mankind upon this earth It broadened the views of the churchmen themselves and of all philosophers To-day the clash of controversy is almost still

Darwin's character was simple and noble The storm of abuse based on ignorance left him unmoved Calm and dignified as a rock, he did not stoop to answer Serene as a statue in a storm, he knew that Truth must prevail He had three stout champions, Lyell the geologist Hooker, the botanist and Huxley, the biologist He felt safe in their hands

He retired to a secluded home at Down, in Kent where with the simplest of tools, he improvised apparatus for his experiments out of old biscuit tins bits of string, and a hammer and a few nails To distinguish the contents of his various bottles and flasks he would tie pieces of coloured wool round them He was a cheerful companion, with a generous, hearty laugh and he liked a bit of fun He

would work during the morning, but his doctor would not let him continue after lunch He would walk round his garden, read a novel, and allow the evening to end without his game of backgammon.

He knew the value of his own work Of the book that shook the world, he himself wrote, 'I look on it as absolutely certain that very much in *The Origin* will be proved rubbish, but I expect and hope that the framework will stand'

He was right Much has gone, much that he himself would have shed in the light of later knowledge, but the main framework stands unshaken It is, as one of his biographers has put it, like a mighty tree in winter from which the foliage has fallen but you can the better see the massive trunk and the branches forking in all directions Much may be rejected even yet But one outstanding fact remains unshaken, that Charles Darwin revolutionized the method of modern thought. His influence has permeated the whole activity of modern philosophy From Medicine to Engineering, in Chemistry and in Astronomy, men think to-day in terms of Evolution So it was that the boy who was a dunce at school lived to revolutionize the method of men's thoughts and to be buried in Westminster Abbey

Family Science

A TASTE for scientific enquiry does not often run in families, but there are some brilliant exceptions Rather curiously, two striking cases are linked together

There is the well-known scientific family Becquerel, of Paris The first Antoine Cesar, was born at Chatillan in 1788 He became an engineer officer in Napoleon's armies, and took part in plenty of fighting in Spain and France After the fall of Napoleon in 1815, he retired from the army and devoted himself to science He was especially interested in electricity, and for his researches in this subject he received in 1837 a great distinction, the Copley Medal of the Royal Society of London He worked on the growth of plants, and magnetism, and the study of the weather, and published a great deal He became Professor of Physics at the Natural History Museum in Paris in 1837, and held the post till he died in 1878 at the age of ninety

His son Alexander Edmond, born in 1820, succeeded him as professor at the museum He devoted himself to the study of light

When he died in 1891, he was followed in turn by his son, Antoine Henri, who was born in 1852 Antoine was a civil engineer by profession, but on his father's death succeeded to the Chair of Physics at the Natural History Museum in Paris thus making what must be a record

It was this grandson who became the most famous of the three He was making a series of experiments

on the nature of fluorescence, that is, the propr't some things have of glowing with different colour In making one of these experiments he was using piece of ore containing the metal uranium, tl heaviest of the chemical elements then know which has this peculiar property of fluorescence H wrapped a piece of the ore in black paper so as shut out light, and left it for some time under photographic plate When he opened the pack he found a feeble but quite distinct photogra printed on the paper

This was a very simple experiment, but tl result was extraordinary As light was shut ou the photograph must have been made by some oth kind of ray For the same reason it had nothing do with fluorescence It must be due to somethin mysterious coming out of the uranium ore itself

He next put the piece of uranium ore near simple apparatus called an electroscope This is a extremely delicate appliance for detecting ver faint currents of electricity It showed that som thing like electric waves were coming out of th uranium

Becquerel III had discovered a new kind o matter, matter that gives out rays, radiant matte in fact His discovery led to a complete revolutio in Physics For his great service to natura science Becquerel received the grant of half th Nobel Prize for Physics, the other half being grante to a certain lady *He died in 1908*

His discovery was so extraordinary that it was met rather sceptically by some scientific men But another Frenchman, Pierre Curie, Professor of Physics at the Sorbonne in Paris, took up the study



Madame Curie

He was helped in his work by a Polish lady, Marie Sklodowska, daughter of a professor who had come to Paris to study Physics Curie married her, and the two set to work to examine this remarkable new thing

They worked systematically through the chemical

elements to see if any others besides uranium behaved in this strange manner, and found the same property in thorium But the minerals containing thorium and uranium are not common, and it was not easy to get the material to work with The chief source of uranium ore was at Joachimstal, in Bohemia, then part of Austria, where a mineral called pitchblende was worked by the Austrian government for the sake of the uranium in it. The Austrian government generously placed a ton of their residues at the disposal of the Curies

Their work, patient and laborious, was well rewarded, for they found in the pitchblende no fewer than three quite new kinds of elements, to which they gave the name radium, because it radiates, polonium, in honour of Mme Curie's native land, and actinium But the quantities of these elements are so excessively small that they are very precious, and very difficult to handle Out of a whole ton of pitchblende, about half consists of uranium Out of this the Curies were able to extract only *three grams* of radium Of the other two, the quantities are so small that they can only just be detected It takes so much work and time to get so tiny a quantity of radium out of so big a mass of ore that the price is about fifty thousand times that of gold

The scientific world at last realized what a tremendous discovery had been made In 1903, the Royal Society awarded the Curies husband and wife together, the Davy Medal, and in the same year the Nobel Prize for Physics was awarded to Mme Curie and Professor Becquerel jointly In 1905, Professor Curie, was elected to the French

Academy of Science

The two sciences of Chemistry and Physics were revolutionized by these new discoveries, which, however, could not be digested at once Hardly more than thirty years ago, an eminent professor of Chemistry in London, when asked by his pupils to tell them something about the wonderful new element of which they were reading in the newspapers, looked quizzically at them, hesitated a moment, and then said

'Gentlemen for information about radium I refer you to *The Daily Mail*'

To him, at the end of his career, the claims for this new discovery were incredible and incomprehensible He could not believe in radiant matter much less in the truth of that dream of the alchemists of old, that one element can be changed into another Yet it was not long before Professors Soddy and Rutherford showed that radium is always breaking up, or rather breaking down, and the results are other stuff, quite well-known including the gas called helium and—lead!

When they were so well launched upon the new science tragedy stalked the devoted couple On April 19th, 1906, the scientific world was shocked to hear that Professor Curie, while walking in the street, no doubt absorbed in thought, had been struck by a cart and killed instantly He was only forty-seven years of age

His widow carried on the work, to which she devoted the remaining twenty-eight years of her life She established the new science upon a firm basis, and when in January 1943 she died at the age of sixty-seven, she was described by Professor

Soddy as 'the most famous woman of all time'

Everything to do with the radiant matter is extraordinary Not the least remarkable is its independence Man can effect no more control over its behaviour than he can over the movements of the stars The radium goes on radiating and breaking down, and man can neither hasten its work nor delay it, much less stop it It is quite aloof from human control

Then came Mme Curie's daughter, brought up naturally, as keen a chemist and physicist, as her mother She, too, married a physicist, M. Joliot but rightly retained her own famous name as well. *Thus Mme Joliot-Curie and her husband continued* the work They carried it a step further, Mme *Curie's daughter was the first human being to produce radio-activity artificially* She has recently produced a new element if we can call it element which she has herself made she calls it radium-sodium It behaves in the same way as radium and the other radiant elements, and as it can be used like radium for healing, its discovery has brought down the fantastic price of radium

Mme Joliot-Curie is a young woman What contributions to Science may she not make yet?

The Man who Conquered Smallpox

In the middle of the eighteenth century there lived at the little country town of Berkeley in Gloucestershire in the West of England, a country parson named Rev Stephen Jenner He was vicar of Berkeley, belonged to an old county family, and owned much property in the district When he died, in 1754, his son Stephen took his place, and acted as father to his little brother Edward, then aged only six



Edward Jenner
From the portrait by Sir Thomas Lawrence reproduced by the kind permission of The Royal College of Physicians London

While quite a boy, Edward showed a keen interest in natural history, and decided to become a doctor He began his studies under a surgeon named Ludlow, who was in practice not far from Gloucester, where he saw a great deal of the country folk One day, about 1768, he heard a dairymaid who had come into the surgery about some ailment, say that there was smallpox about, but she was not afraid as she had had cowpox already Now smallpox is a

terrible disease, but cowpox, though rather like it is not nearly so serious. Jenner was interested, and began making enquiries among the country people, and found that the belief was general that cowpox acts as a protection against small pox. Cowpox as the name suggests, is a disease of cattle and diarymaids are liable to catch it.

When he was twenty-one Jenner went to London to study under John Hunter, a famous teacher of Medicine, with whom he lived for two years. Here he met many interesting, men, including Sir Joseph Banks, the botanist, who had recently returned from his famous voyage to Australia with Captain Cook. Banks asked young Jenner to arrange and prepare all the specimens of natural history which he had brought back. Jenner did the work so well that he was invited to join the second expedition. It must have been a tempting offer to a keen young naturalist, but Jenner was too intent upon his profession, and too devoted to his elder brother and home to accept it. He returned shortly afterwards to his native place, where he took an active part in founding a local medical society. He kept up correspondence with Hunter, under whose advice he continued his observations on various branches of natural history, and in 1792 he took the degree of Doctor of Medicine of St Andrews University in Scotland.

Jenner took an active interest in the life and affairs of his native district. He made the first balloon ever seen there. He was a cultivated man and socially a great favourite. He could sing well, was a poet in a small way, and a good performer

While living in London he had told Hunter about the country belief in the protection against smallpox given by cowpox, but the great man paid little attention to it Back in the country, Jenner began to collect evidence He asked his colleagues who all said that they had heard of the belief from the country folk, but looked upon it as mere superstition Jenner, however, continued to think that there might be something in it The ideas of country folk, if not founded on learning, are often based on long observation

It was about 1775 that he was able to start making regular notes He quickly confirmed his impression that all the country people were firmly settled in their belief But when he investigated carefully all the cases he could hear of he found that there were many persons who had had both diseases This was discouraging, but he persevered with his inquiries Cowpox was not very common, and it was five years before he discovered that there were two distinct complaints confused under the name Only the real cowpox gave protection the other that was mistaken for it not being of any help That accounted for the cases recorded in which cowpox had not prevented an attack of smallpox

The only way in which the country belief could be tested was to give some healthy person cowpox and see whether it did indeed protect that person from the more serious disease On May 14th 1796, Jenner inoculated a boy of eight named James Phipps with matter taken from the cowpox blisters on the hands of a dairymaid Sarah Nelmes, and a fortnight later he carefully inoculated him with real smallpox It was a bold thing to do, and Jenner

confident though he was, must have had an anxious time waiting to see what would happen. He foretold that the boy would not suffer from smallpox. He was right.

Cowpox was so scarce in the dairies that Jenner had difficulty in finding more material, and it was two years before he was able to repeat his experiment.

This confirmed his assurance, so he wrote a treatise on the subject, under the title *Inquiry into the Cause and Effects of Variolae Vaccinae*, but before actually publishing it he decided to go to London to consult doctors there and, if possible make some more experiments.

He spent three months looking for someone who would consent to be inoculated with the fell disease which is hardly surprising, and returned home without further result. But the surgeon of St Thomas's Hospital, Henry Cline, to whom he had given some of his vaccine of cowpox, gave it to a child suffering from disease of the hip joint, as he thought the counter-irritation might do good. The result was that the child was found to be protected against smallpox.

Cline at once became a supporter of Jenner, but while most doctors preferred to wait for more evidence, many took a strong stand against inoculation, calling it a rash and dangerous practice. But the dread of smallpox was so widespread that the public were deeply interested, and most were ready to run any risk for the sake of protection against so fearful a scourge. Some harm was done by some of the injections supplied by Jenner, but this he found, was due to some infection in the vaccine.



Jenner vaccinating his son

Obviously, it was of prime importance to have the vaccine quite pure and not contaminated

By 1799 the practice of vaccination had spread over England Ignorant quacks even set up business as vaccinators One charlatan named Pearson had the impudence to start a vaccination clinic in London to supply vaccine to all who might want it for a good price, of course and went so far as to offer Jenner the post of honorary physician The risk of misuse was so obvious that Jenner came hurrying to London at once, and he succeeded in getting the project stopped

He had now achieved fame and the gratitude of

thousands He was presented to the King and Queen and to the Prince of Wales, and the royal family helped to spread the good news that smallpox was at last conquered It flew all over the world Jenner was hailed as a great benefactor of mankind, as indeed he was In Holland and Switzerland clergymen recommended vaccination from the pulpit, and in Roman Catholic countries religious processions were formed to receive the vaccine In Germany, Jenner's birthday or the anniversary of his inoculation of the boy Phipps was celebrated as a public holiday The Empress of Russia decreed that the first child vaccinated in her country should be named Vaccinoy and be educated at the expense of the State In 1807 vaccination was made compulsory in Bavaria, in Denmark in 1810, in Sweden in 1814, and most other countries in the world followed

Only in the land of his birth was Jenner treated as anything but a saviour True, on a petition of his friends, a grant of £10,000 was made to him but it was not paid for two years, and after, £1,000 had been deducted for expenses, he had left over hardly more than enough to cover the cost of his work He vaccinated hundreds of poor people every week, free of charge While foreign honours and decorations were showered upon him, Oxford University, declined to grant him the degree of M.D unless he passed an examination in the Classics! That, he said, he would not do for a diadem

So great was the gratitude of mankind, that when, on the outbreak of war with France, many

arrested and Jenner signed a petition for their release, Napoleon exclaimed 'We can refuse nothing to that man!' Englishmen detained in Austria and Mexico were released at Jenner's request, and many actually used as passport letters signed by him His signature was honoured everywhere But in his own country no attention was paid to his petition in favour of French prisoners and he was not even able to find employment for his son George

Still, his many friends worked hard on his behalf, and as a result of their agitation the Government voted him in 1806 a grant of £20,000 without deduction A public subscription raised for him by grateful people in India brought him £7,383

In 1810 his eldest son died, and the blow affected his health, overstrained by his untiring work to save others He paid his last visit to London in 1814, when he was presented to the Allied Sovereigns The next year his wife died, and from that day he never again left his native town of Berkeley In the beginning of 1823 he presented to the Royal Society a paper on the migration of birds On January 25th of that year he had an apoplectic fit in his library, and the next morning he passed away

It is characteristic of the extraordinary attitude of his countrymen that it was not until 1858 that a statue was put up to his honour in London by public subscription, and his process of vaccination compulsory in most countries of the world for nearly half a century, was not made so in England until 1853 Even now the anti-vaccinators are so strong that they have persuaded Parliament to give

exemption to those who swear before a magistrate that they 'conscientiously' believe that it is dangerous to the health of their child

Since the boy Phipps was vaccinated in 1796 how many millions in all parts of the world have had cause to bless that English country doctor!

Ferments and Germs

It is a curious thing that the greatest advance in one step in the history of Medicine was made by a man who was not a doctor. On December 27th, 1822, in the little country town of Dole, in Franche-Comte in central France, the wife of a tanner named Pasteur bore a son to whom was given the name Louis. That child was destined to be one of the greatest benefactors of the human race.

When he was sixteen, he was sent to Paris with a friend to study in the Latin Quarter. But Louis, who was a nervous boy, did not like the bustle of Paris, and longed for the quiet life of the country. 'If only I could get a whiff of the smell of the tannery once more, I should be all right again,' he said to his companion. He went home, but his ambition for education took him to the towns again, and he went to the Royal College of Besancon, where in 1840 he took the degree of Bachelor of Letters. Two years later he took the same degree in science. It is rather curious that as a lad he does not seem to have shown any signs of brilliance, and even in the subject in which he was to win undying fame, chemistry, his work was described as 'mediocre'. The key to his success was not brilliance, but sheer hard work and persistence



Pasteur in his laboratory From the painting by A. Edelfelt

He was gifted with the infinite capacity of taking pains The weapon he wielded was exactitude

As quite a young man he made a discovery that till then had baffled all The great Swedish chemist, Berzelius, had known that the substance called tartaric acid, made from lees of wine, sometimes behaves in one way, sometimes in another there

seemed to be an active form and an inactive form, yet the substance was the same The great Frenchman Biot had also known the fact, but neither could understand it

Pasteur showed that really there are two distinct kinds of acid in the one substance If a ray of polarized light be thrown through a solution, one acid throws it to the right the other, a new kind to the left When he told Biot about this, the old gentleman was incredulous, and made his young friend repeat the experiment in his presence Pasteur was successful, and Biot delighted From that moment the old man treated him as a son

This discovery made Pasteur's reputation as a serious chemist, and the result was the offer of the post of Professor of Chemistry at Strasbourg Thus launched upon life, he married a lady named Laurent, who was to make him happy for many years

He next tried to make the inactive form of the acid He found that when it was placed with a mould, the right-handed acid was destroyed, but not the left-handed Inquiry into this led him to far greater discoveries By 1854 he had established such a position that he was appointed Professor of Chemistry and Dean of the Faculty of Science at Lille

In his opening address he made a remark which should be taken to heart by all workers, although it was intended only for men engaged in scientific research He said 'Chance favours only those who are prepared' When his chance came, he was prepared

He was one day consulted by a brewer, who

asked him to try to find a cure for some defect in his beer, which was then causing heavy losses in the industry Pasteur set to work to examine the yeast under the microscope, and found two kinds, one round, the other long The round yeast came from the good beer, the long yeast from the bad beer He followed up this clue diligently and the result revolutionized the science of biology He showed, to the confusion of the old philosophers that *there is no such thing as* 'Spontaneous Generation' That means that Life cannot arise by itself, that every living thing has parents, even the most minute creature that cannot be seen without the microscope

Now everybody knows that when beer and wine are made, alcohol results, that when vinegar is made, acetic acid is produced, and when milk turns sour the result is lactic acid Pasteur showed that the process by which all this happens, *fermentation*, is brought about by the action of minute creatures called bacteria, or ferments Different kinds of ferment produce different kinds of fermentation Pasteur showed that putrefaction is a kind of ferment and many diseases are caused by just such tiny organisms

He showed, too, that if you shut these ferments out, no change takes place If you kill the ferments you stop the change He saw that the same ideas could be applied to many diseases.

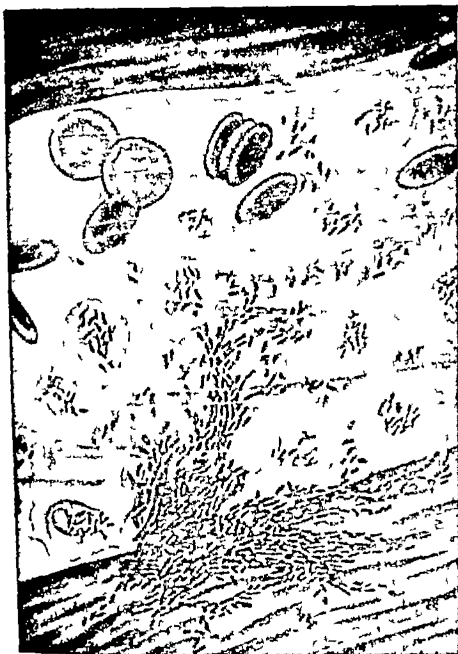
The results of these discoveries were the most far-reaching of the century They replaced brilliant guesswork by exact scientific method, experiment, observation and record Pasteur profoundly modified the whole basis of medicine surgery, physiology,

biology, and all the arts and industries which are based upon some form of fermentation He placed bacteriology upon a scientific basis

He applied the same method to the industry of wine-making, which is so important in France It was at that time suffering severe loss owing to a kind of wine-sickness Quickly he traced the cause, found the cure, and restored prosperity to the wine-growers Then he did the same thing for the silk industry, by curing the epidemic which was killing off the silkworms

He next turned his attention to the possibility of finding protection against diseases, and immunity from them He did the same thing that a gardener does when he removes all weeds from a bed, so as to have only one kind of plant in it Pasteur found that he could make such a special bed of each kind of ferment, only he did not call it a bed but a culture He next found that by continuing to produce such cultures under certain conditions the poison made by those ferments which cause disease became feebler Then came the crowning discovery, that when this enfeebled poison is given to an animal, that animal is protected against the disease. The poison is called a toxin and the antidote an antitoxin The preparation made from the animal is usually called the serum, as it is made from the serum, or thin fluid part of the blood

Now in the blood there are a number of pale little things called white corpuscles They are the policemen of the blood When germs enter the blood, these corpuscles come flying to the rescue crowd round the enemy, and devour him If the sufferer is strong enough and has enough of these



White corpuscles in the blood resisting an invasion of typhoid germs
The lozenge like corpuscles are the red corpuscles that contain oxygen

policemen in his blood, they will win and he will get well But if the germs are stronger, they will become so numerous and make so much poison inside him, that he will be in danger of death. Then, if the proper culture be injected into him, it acts as an ally, summoning the antitoxins to the fray It stimulates the patient to build up the antitoxins of his own powers In fact, the culture mobilizes the natural forces of the sufferer, just as a country mobilizes its forces to repel an invader

Acting on these lines, Pasteur found cures for two diseases which were causing a loss of about 10 per cent of the food supply of France chicken cholera, and anthrax in cattle and sheep In both he reduced the death-rate to about 1 per cent. He did not sell these discoveries, but made them a free gift to the world Such services cannot be measured in money, but it was the opinion of one of the greatest men of science of the period, T H Huxley, that the money saved by those discoveries was enough to pay for the war indemnity extorted from Pasteur's country by Germany in 1871 That is to say, more than £300,000,000 in gold

The next discovery by this remarkable man was so startling that for a time the world could hardly believe it It was a cure for that most mysterious and horrible of all diseases, hydrophobia He made experiments on dogs, as they are the chief carriers of the disease, and by injecting one with the weakened venom, found that he had made it immune against infection, that is he had given it protection He worked long and hard, until at last, in 1885, he dared take the responsibility of trying his serum upon a human being It is not hard to

imagine the nervous strain upon both, the experimenter and his patient, as he made this tremendous experiment, or the hopes and fears that filled his heart Was he going to remove from the world that awful malady, which had till then defied all treatment—a malady so terrible in its symptoms, so terrifying in its effects, so cruel in the torturing death which it had till then never failed to inflict?

He was successful

On November 14th, 1888, there was opened in Paris the Pasteur Institute to which sufferers flocked in thousands It was not many years before the death-rate from the foul scourge was brought down from 100 to 1 per cent

Unspoilt by the honours showered upon him simple-minded and unaffected, this truly great worker and benefactor of mankind, the results of whose work have saved more human lives probably, than those of any other individual, passed peacefully to rest at the age of seventy-three on September 28th, 1895

A Simple Frenchman

In the year 1775 there was born in a village near Lyons, in France, a mathematical prodigy He was working out sums in arithmetic before he could read and write, using pebbles His name was Andre Marie Ampere

His father, a respected magistrate in Lyons began to teach the boy Latin but soon found out what a talent the boy had for mathematics, so the Latin was allowed to drop Andre found, however,

that he wanted to read the works published by mathematicians in Latin, so he asked for the lessons again By the time he was eighteen, as he wrote afterwards, he knew as much of mathematics as he ever knew But he was no narrow pedant. His active brain took an interest in many subjects He was a great reader, eagerly devouring all the serious books he could find on history, travel, poetry, philosophy and, above all the natural sciences

In 1793 the soldiers of the French Revolution took Lyons Ampere, the father, had courageously protested against the horrors they had committed and so they showed him little mercy He was flung into prison and not long afterwards, like most moderate men, he had his head cut off upon the guillotine

Andre who was of a sensitive and affectionate nature was so horrified by the shock of his father's murder that he abandoned work and seemed sunk in a kind of dazed stupor for nearly a year One day some letters on botany chanced to come into his hands, and as he glanced through them the keenness of his intellect was at once aroused There can be little doubt that those letters saved his reason He worked hard at botany for a while, and then turned to the classic poets Perhaps it was because of a lady that he took to writing verse himself The lady's name was Julie Carron, whom he met in 1796 Ampere fell in love with her, and three years later they were married

Times were difficult, but Ampère earned his living by giving lessons in mathematics chemistry and languages in his native city In 1801 he moved to Bourg to take a post as professor of physics and



Andre Marie Ampere

chemistry, an opening which he could not afford to miss Unfortunately, he was for some reason obliged to leave his young wife, who was ill, with her baby boy

In 1802 he published a small treatise on the mathematical chances of gambling, in which he showed that the odds are heavily against the player This attracted the attention of an influential man in Lyons, who secured for him the chair of mathematics in the college of his native town in 1804

By the irony of fate, this move, which should hav brought him so much happiness, came too late fc in that same year his beloved wife, who had bee ailing for several years, passed away, and Amper was heart-broken He never really recovered fror this second bereavement

To distract his mind from the familiar surround ings, his friend then obtained for him a small post i Paris, in the Polytechnic School, where he soo after was elected professor He found time, in spil of his teaching duties, to carry on his scientifi experiments In 1814 he was elected a member c the famous Institute of France His reputation wa expanding, and eventually developed into a fam based firmly on his success in showing the clos connexion between electricity and magnetism, wh he called the science of electrodynamics Oı September 11th, 1820, he heard of an observatioı made by a Dane named Oersted, that a curren from an appliance called a voltaic pile acts upon a magnetic needle, Stimulated by this, only a week later he presented the Academy with the most complete account of such phenomena that yet existed That, and the later researches based upon it, were the chief work of his life, and in recognition of its value his name has been given to one of the chief units of electricity, the unit of current, the ampere

Ampere died at Marseilles on June 10th, 1836, leaving a name firmly engraved upon the annals of science and, for the gentle, almost childlike simplicity of his character upon the hearts of his friends

A Blacksmith's Boy

In a little village in the north of England a century and a half ago there was living a family of hard-working country people, poor, and highly religious, members of the strict Christian sect known as the Sandemanites One of these, by name James Faraday, was somewhat more ambitious, or perhaps enterprising, than his nine brothers and sisters, for he married a farmer's daughter and migrated to London, where he set up a blacksmith's forge on the south side of the Thames, where two main roads met Here, he thought, there should be plenty of business for a good blacksmith, as there was heavy horse traffic upon the roads It was, of course, long before the days of Railways

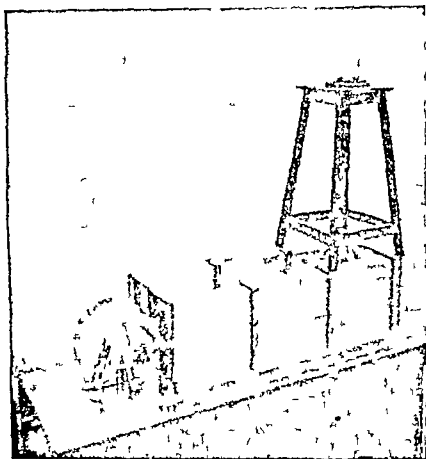
For some reason, perhaps because of poor health, James Faraday did not make a success of his business, and the family lived in the cheapest of lodgings, in some mews at the back of fashionable houses His third son, named Michael, born on September 22nd, 1791, was destined to be one of the greatest men of science to whom Britain has given birth

Michael grew up in a very poor home, in an air of piety, honesty, and hard work, virtues that marked him throughout his life Directly he was old enough to be able to do so at the age of thirteen, Michael who had learnt to read and write at a day school found a job as errand boy in a bookseller's shop He was so alert and hard-working that his master accepted him as an

apprentice to the trade of book-binding without charging the usual fee The boy was delighted, as it gave him the opportunity of reading the books he was handling, and we are hardly surprised to know that serious articles in the *Encyclopaedia Britannica* were his favourites, and a book that to-day would seem very naive and quaint, *Conversations on Chemistry*, by Mrs Marcet.

Through this reading he became strongly attracted by chemistry and electricity both of which sciences, of course, were in those days in their childhood When he was nineteen a customer of his employer, a Mr Dance, was so attracted by the youth's keen interest that he took him to hear four lectures by Sir Humphry Davy, the Professor of Chemistry at the Royal Institution Michael, in delight, took copious notes, and wrote them out in full afterwards

He had for a long time carefully cultivated the taking of notes and had been earnestly studying English, especially the art of expressing himself clearly and accurately, both in writing and speaking We may be sure, therefore, that his notes were excellent, and when he bound them beautifully himself, and sent them round to Sir Humphry, that distinguished gentleman was naturally much impressed Accompanying the volume was a letter in which young Faraday asked for employment in the laboratory of the Royal Institution The reply was prompt and encouraging On March 18th, 1813 Michael Faraday was appointed laboratory assistant at the Royal Institution at a salary of twenty-five shillings a week, and with the use of a couple of rooms at the top of the building



Faraday's magnet and copper disc

Further good fortune awaited him Davy was a remarkable man, the most distinguished English chemist at the time a gifted man of the world as well, and he was so impressed by young Faraday that he took him as secretary and assistant upon a tour through France Italy and Switzerland which lasted from October 1813 to April 1815 Davy gave lectures, for which Faraday prepared the apparatus.

This gave him the chance of meeting the grea scientific Europeans of the day Richly must hi receptive mind have been stored with memorie and impressions when he returned to London, tw months before the battle of Waterloo

On resuming his duties at the Royal Institution his salary was raised to *thirty shillings* By 181 he was not only busy with his duties, but foun time to add to his modest income by taking pupils He acted as assistant to Brande, who succeeded Davy at the Institution, and, while constantly im proving his own education, was making experiments himself In 1820 he read his first paper before the Royal Society It was now that his genius at making experiments found its real scope

In 1821 he was promoted Superintendent of the house and laboratory This enabled him to marry, and he brought his bride, Sarah Barnard, daughter of a Sandemanite elder, to his rooms in the Institution He was thirty years of age, and now he entered upon the important period of his life For forty-six years the couple lived in those modest quarters in the austere happiness which their sect ordain In 1825 he was appointed Director of the Laboratory, and his salary raised to £100 a year In the same year he was elected a Fellow of the Royal Society In 1835 he was appointed Professor This was for him a magnificent thing, as he was not obliged to give lectures, and could devote his whole time to research

His output of work was immense Famous were the series of lectures which he gave on Friday evenings, and 'Faraday on the Chemistry of a Candle' has become a classic He conducted

research into an astonishing variety of subjects, into numerous problems of chemistry and physics Though his contributions to chemistry were very important, it is his work on magnetism and electricity that is far the greater The crowning discovery of all was the result of ten days hard work experimenting in 1831 He spun a coper disc between the two poles of a horseshoe magnet The effect of this was to induce, that is to bring on, a current in the disc This starting of a current in a conductor of electricty is called *induction* and the effect is to turn the *mechanical* energy of the spinning wheel into the *electrical* energy of the flowing current The simple experiment led eventually to the invention of the dynamo and electric motor Those days may, perhaps, be regarded as the most important ten days in the history of electrical science, for upon them is based the whole of modern electrical engineering

Although he never sought honours, they were showered upon him by monarch, governments and universities He declined the Presidential Chair of the Royal Society and also the professorship at London University He was constantly consulted by authorities, and in his later life was making an income of over £1,000 a year, which to his unassuming mind meant wealth indeed Riches were his for the asking but he considered only his work He gave up most of his fees and died, as he had lived a poor man He was intensely religious On one occasion only did he fail to be present at the all-day Sunday service of his sect, and that was when he was commanded to lunch with Queen Victoria For that offence he was excommunicated, but in view

of his fame, he was afterwards readmitted to the fold

Curiously, like Darwin, he was no mathematician It was as an experimenter that he stood unrivalled, and Michael Faraday ranks without dispute among the greatest investigators of Science that the world has seen, with Archimedes, Galileo and Newton'



Among the sugar canes of Hawaii

How the Sugar Crop was Saved

In those isles of perpetual summer called Hawaii, or the Sandwich Islands the chief source of wealth is sugar Tens of thousands of acres are under the sugar cane, and most of the inhabitants depend, in one way or another, upon the crop

The planters, however, do not have it all their own way, for they have a tiny but serious enemy That is a little whitish maggot with a dark brown head, which turns into a dull little brown weevil, a beetle with a snout, about an inch long It bores into the canes for home and food, and, of course, when a cane is infested it grows weak or dies This miserable little maggot was for a long time costing the planters something like a million dollars a year

So the Association of Sugar Planters declared war upon the weevil They mobilized the women and children and sent them into the hot, steamy plantations to pick and collect the beetles and grubs, and bring them in to be burnt The quantities they collected were huge In one year they brought in 2,641,725 ounces of the beetles and grubs, for which they were paid 25 cents per ounce

As there are about three hundred beetles to the ounce, nearly eight million of the insects were caught and destroyed in that season If they had been left in the canes to do their evil work what tremendous damage they would have done! They would have made an enormous hole in the harvest

But even this did not seem to keep the beetles down really effectively In most countries there are animals that feed on creatures like that and keep the numbers down but in Hawaii which is far away in the mid ocean, away from any mainland, there are not very many animals birds or useful insects to help the planters There are some ants which destroy the maggots, a few mongooses some toads and two or three kinds of birds in particular the mina, all of which are useful to the planters, but there are not enough of them to be

really helpful It is curious that here rats are regarded as friends of man, instead of a hated pest. The rats rather like the taste of the maggots, and gnaw their way into the canes, which are already bored by them, to devour the grubs

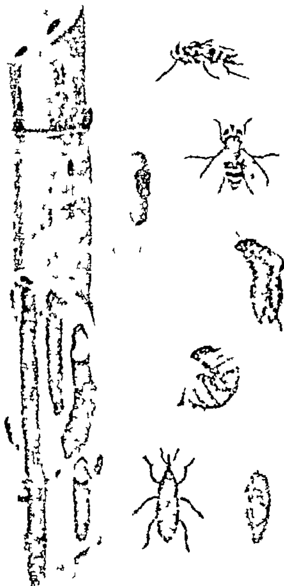
Finding that they could not cope with the pest, the planters decided to employ a specialist, an entomologist named Muir, who had done some very good work in finding means of getting rid of another insect pest

Muir decided to act on the principle of 'Set a thief to catch a thief' He felt sure that somewhere in the tropical orient there must be some kinds of insect that feed on the weevil If he could find them, breed them, and let them loose in Hawaii he might conquer the pest But the thing was—where could he find that ally?

The first step was to find the original home of the beetle, for it was not really a native of Hawaii. And as sugar-cane is grown all over the east, he had to guess where its home might be It was like looking for a needle in a haystack.

In July 1906 Muir sailed from Hawaii on his quest. He intended to comb out the chief sugar-cane countries systematically from west to east The first place he saw was south China There he spent six months in the steamy plantations, hunting every day for the boring grub, but he did not find it Then he went to the Malay States and worked there for several months, again without result. Next he went to Java No better luck there either

By that time he had been away a year, hard at work in a bad climate But he was not disappointed He knew what a long and difficult job he had, and



The sugar-cane beetle at work and the fly which gets into the maggot of the beetle and by feeding on it kills it

was sure that if he persisted he would win in the long run But it cost money Would the planters go on ?

He reported to his Association that he had so far drawn blank, but had a clue The Association gave him more funds, and told him to go on with the search

He went first to Borneo, landing at Pontianak on July 24th, 1907 Pontianak, which had been a Chinese settlement long before the Dutch took it, is on a marshy, malarious site He had to steam for nine hours up a winding stream lined with palms and mangroves, reeking in the moist, tropical heat, till he came out into lowland forest scenery, with the tops of rattans waving gracefully above the trees The houses are built on piles, with a couple of feet of water beneath them at high tide The soil is soft peat, and the drinking water the colour of strong tea—not very appetising but not unwholesome to drink In this strange spot he worked hard for some time, but still without result.

There he accepted an invitation to visit a planter at a place called Teloc Ayer, an all night journey by river There, too, he failed to make any discovery Then he went farther up still, three days by canoe and two on foot, to a place called Moewong The place was so interesting, he wrote afterwards, that he could have spent a lifetime there He found that the famous Dyaks who live there are no longer the savage head-hunters they used to be. The only heads they hunt to day are the heads of *the Dutch queen upon her silver coins*

His visit to Borneo was interesting, but he had not found his weevil So he returned to Java, and

sailed thence for the Moluccas He next tried Amboina, a hilly island clad in dense forest where he arrived on October 10th, 1907 He liked the Amboinese, whom he found pleasure-loving folk, fond of singing and dancing The rhythmic music of their tomtoms as they rowed used to lull him to sleep in his canoe In this pleasant land he hunted his grub for several weeks, but in vain

Next he tried Larat, a big island in the group called Tenimber Here he found hospitality in the house of the Dutch administrator, and he set to work in real earnest, for he had information that his beetle was there For the first ten days he explored the island to find the sugar-cane The canes were too young, but he found plenty of the weevil in sago and betel palms Here, he thought, was a likely spot in which to find the ally for which he was hunting It was exhausting work Often he spent hours on end standing in ten inches of water The brittle leaves of the sago palms broke off in his flesh Mosquitoes drove him mad, even when he covered his head with a net But still he persisted For five weeks he worked He opened thousands of cocoons of the maggot, but not once did he find a sign of its enemy for which he was looking So he said good-bye to his kind friends and returned to Amboina

In Larat he had learnt a good deal more about the habits of the weevil, although there it was living in palms, and not in sugar-canes At Amboina also he found it in the palms Here at last he found a clue He had suspected that there was a kind of fly which preyed upon the weevil and he was right There is a family of flies called the

Tachinidae which look very much like the common septic house fly, but have very different habits. They lay their eggs in the grubs of other insects, so when their young hatch out they have plenty to eat right under their noses Muir had long felt sure that he would one day find the right kind of *Tachinid* But to be a useful ally, the fly must be very numerous, be able to breed in cages, and its life history must be studied carefully, so that he could organize the transport of a stock of them back to Hawaii alive

He found that in places where the palm grows like the cane in Hawaii, the fly kept the beetles down Here he decided was his ally He had done the first great step in his task Next came the job of collecting quantities of the fly, breeding it in numbers, and taking a stock back alive to Hawaii That was a difficult job, as the fly's life is short and there was no direct line of steamers So he sent a colleague to Hong Konk, to start a breeding station there as a half-way house, and sent a consignment from Amboina But the flies died on the way, and the result was a failure

So Muir decided to take a consignment himself By dint of much care and trouble he managed to keep his flies right up to the very last day, but then, for some unknown reason, they all died the day before he reached Honk Kong !

The job of transporting quantities of the precious fly seemed a harder task than finding it. He heard that the weevil was known at a place called Fak-fak in British New Guinea That was nearer to Hawaii, and he felt it very probable that the fly would be there too, so he packed off to Port

Moresby, and went to stay with a planter, Mr Rattle, on the Laloki river, some fifteen miles from the coast Within an hour of arrival, he had found both weevil and fly

He settled down there in earnest to breed a big stock of the fly It was now April 1909, and his reports encouraged the Association They told him they would go on finding the money, so that he could complete his work He managed to accumulate a large stock of the fly in his breeding-cages, and started off to Australia in triumph on his way to Hawaii

But before he went on board he collapsed with typhoid When he reached Brisbane he was put straight into hospital His precious flies were sent forward, but without his skilled attention they were all dead upon arrival at Honolulu, those flies on which had been spent so much money and toil

He recovered, and as soon as he was strong enough, began again He established a breeding-station in Queensland, and landed back in New Guinea on February 7th, 1910

Here he found a gold rush Port Moresby was crammed with adventurers Labour was as rare as bedrooms But by February 11th he had found a kind of conveyance called a buckboard on which to drive out to Mr Rattle's The road, he said was pretty good for New Guinea, but very bad for buckboards It took him five hours to travel twelve miles, down to the river, where he shouted till Mr Rattle's boys came down stream to pick him up Mr Rattle was away, but had left the keys for him to make himself at home He set to work at once

By April 21st he had a stock of the flies, so he took them down to the port to ship for Queensland but the boat was late, and then he was seized with fever He was eventually carried on board, and when he reached the breeding station in Australia, he was nearly dead The presence of his colleague there saved the situation

When he recovered, he took a stock of the flies to Fiji, to make another breeding-station there No sooner had he landed than once more he went into hospital with malaria. He recovered, and on August 16th, 1910, he landed at Honolulu, with a good stock of his precious flies alive Thus he achieved his task

Four years had been spent on the hunt, gallantly spent by Muir, gallantly supported by the planters The fly was bred in numbers, and released among the canes Our strange little ally did its work Muir had justified himself He had spent four years in tropical jungles, exposed to every kind of infection, undaunted by difficulties and repeated disappointments But he had saved many millions of dollars and delivered Hawaii from its most destructive pest, and by his perseverance and resource had set an example to all mankind

Wireless

Wireless telegraphy is generally considered a quite modern invention, but it took a hundred years to grow As long ago as 1838, K. A. Steinheil found that a return current could come back through the earth, and all through the nineteenth century men were trying to work out a system of

telegraphing through space without the use of wire Morse, at Washington, inventor of the famous code, made a step forward in 1842, and was followed by several experiments The first man actually to send a signal through space without wires was a Scot, James Bowman Lindsay, of Dundee, who succeeded in sending experimental messages cross the river Tay between 1845 and 1854 In 1864 that mathematical genius, Clerk Maxwell, foretold on theoretical grounds that, just as there are waves of light, so there are waves of electricity In the seventies an American, Elihu Thompson, was making experiments in what seemed to most people a fanciful idea, that is, of sending electrical waves through a brick wall without the use of wires But he was far too busy on other things to follow the matter up, and he built up the huge electrical business of Thompson-Houston instead Had he persisted, we might now have been talking about thompsonigrams

Between 1880 and 1890 H R Hertz had proved the existence of the electric waves foretold by Clerk Maxwell He found that they are invisible, but can be reflected like light waves, and travel at the same speed In 1882 Branly, of Paris, found that when metals are powdered, as iron filings for instance, their power of conducting electric current is affected by these mysterious waves of Hertz Other physicists, such as Sir Oliver Lodge, had been at work on the same subject for some time, and had carried out very interesting and encouraging experiments

The first man to make any practical use of them was a young Italian engineer, whose name was

destined to become famous Guglielmo Marconi was born at Pontecchio, near Bologna, in Italy, on April 25th, 1874 His father was an Italian country gentleman, but his mother was an Irish lady, a Miss Jameson, from County Wexford Guglielmo was educated privately in Iatly, and from his earliest years was intensely interested in physics and electricity He followed the work that was being done by experimenters, and by 1895 had become firmly convinced that it was possible to invent a means of telegraphing by waves instead of wires

When he was twenty-one he set to work in earnest making experiments at his home In spite of his home-made and crude apparatus, before the end of the year, he succeeded in sending signals over a mile

The next year he came to England and took out a patent, the first ever granted for wireless telegraphy by means of electric waves and before the end of the year, showed his apparatus to the officials of the British Post Office on top of the roof of the G P O in London

The Post Office officials were extremely interested, and gave the young Italian every encouragement They helped him to carry out more experiments in the south-west of England, and before long he was sending signals over two, then four, and then nine miles

Foreign governments were interested too, the first among them, very naturally, being the Italian So in June 1897 young Marconi was invited to go to Spezzia where he put up a station and succeeded in sending messages to Italian warships twelve miles out at sea After this he was invited to give a



Marconi in 1901 with his receiving and transmitting apparatus

demonstration before King Humbert and Queen Margherita

His progress had been so rapid that by 1897 a company was formed in London to further the young inventor's work. By 1898 a permanent station was put up at Alum Bay in the Isle of Wight, which was able to send signals to Bournemouth, twelve miles away

The first commercial use of Marconi's invention was in 1898, when the Kingstown regatta races

were reported for *The Dublin Express* by him with an apparatus on a tug, which followed the yachts in the Irish Sea, and in the same year, during Cowes Week, he put up wireless apparatus at Osborne House in the Isle of Wight, so that Queen Victoria, who was living there then, could send messages to the Prince of Wales, afterwards King Edward VII on the royal yacht *Osborne* It was a year of records for before it was over wireless was used for the first time to enable lightships to keep in touch with the shore, which was done successfully between the East Goodwin lightship and the South Foreland lighthouse, in a part of the Straits of Dover that is dangerous for shipping The value of this was brought home when a steamer collided with the lightship in March the next year The accident was at once reported by wireless to the South Foreland and lifeboats put out in time to prevent any loss of life

At Easter 1899 Marconi sent a message across the English Channel, and showed that communications could be kept up from the shore with ships at sea. The British Admiralty was alive to the value of this, and in July and August of that year the new system was given a trial during naval manœuvres Two cruisers, the *Juno* and the *Europa*, were fitted with apparatus, and the result was so satisfactory that the officials of the British Admiralty took the matter up very seriously, especially the late Admiral Sir Henry Jack, who himself invented many improvements The navies of the world quickly followed the example The first time that wireless was used by the military authorities was in the South African War

By January 1901 Marconi had succeeded in telegraphing by wireless without difficulty from the Isle of Wight to The Lizard in Cornwall, a distance of about a couple of hundred miles Two public companies were formed at that time, Marconi's Wireless Telegraph Company and the Marconi International Marine Communication Company Stations were put up at suitable points, on many coasts and many ships equipped with the apparatus By the end of 1901 this radio-telegraphy was established on a secure industrial basis

Now he felt justified in attempting the ambition of his life, to send wireless messages across the Atlantic A powerful station was built at Poldhu in south Cornwall It was a great undertaking, as special electrical appliances were required, for which there was no precedent to serve as guide The apparatus was made by J A Fleming, who invented the first wireless valve The station was complete by the end of the year, and Marconi crossed the Atlantic to Newfoundland There, at St John's, he sent up a wire on a box kite and sat down to wait to see if he could pick up the signal with a sensitive appliance called a coherer and a telephone It had previously been arranged that the men in Cornwall would send out the letter S in the Morse Code, that is three dots, at fixed hours The inventor waited with calm confidence to see if his apparatus would pick up that signal, and if it did, to see if those three dots were repeated at the intervals agreed In this way he would be sure that it really was the signal, and was not due to some atmospheric disturbance

Many people had been sceptical The thing was

fantastic Not only was the distance far too great, over two thousand miles, but there came in between Poldhu and St John's the bulge of the curvature of the earth How tense for that young man must have been those hours of waiting! Would that signal come? And would it be repeated?

It came.

From that day there was no going back. In February 1902, Marconi repeated the experiment this time at sea on board s s *Philadelphia* At a distance of 1,557 miles from Poldhu he received telegrams printed on the ordinary Morse tape, sent by wireless By 1904 press messages were being sent cross the Atlantic, and news being transmitted to ships at sea, which were thus able to print their own daily newspapers The use of wireless in the Russian-Japanese war showed the world that a new factor had come into both military and naval operations

In 1906 an international conference was held in Berlin to regulate the new system, and its decisions were accepted by the chief powers of the world

Exactly a century ago, in 1845, an escaping murderer was caught in London owing to an urgent message sent by the electric telegraph with wires which was then a brand-new invention This sensational incident made the public realize that the electric telegraph would have very great practical utility So it was with wireless In 1910 the police wanted to arrest a man named Dr Crippen who was suspected of having murdered his wife It was found that Crippen had escaped from the country and sailed on a steamer called the *Montrose* for Canada The police authorities sent a



Nowadays ships and aeroplanes can keep in constant communication with land Above is the wireless operator at his post on board the famous exploring vessel the *Discovery*

wireless telegram across the Atlantic, asking the captain of the *Montrose* whether on board his ship there was a man of Crippen's description When

the reply came back that there was just that sort of man, the English police sent a wireless message asking the Canadian police to arrest him directly the ship came into port. Crippen was brought back to England and hanged for his crime. Once again it was the romantic capture of an escaping murderer that made the public realize that another great step forward had been made in civilization.

In 1905 the young inventor gave a lecture before the Royal Institution in London, in which he pointed out that most probably wireless messages round the world to places on the other side might be done more easily and with less expenditure of electrical energy than would be required for much shorter distances. People were incredulous, as they generally were when Marconi made prophecies but as usual he was proved to be right. In 1910 he received signals and messages at Buenos Aires which had been sent from Clifden in Ireland, a distance of about six thousand miles.

Another step forward was made on September 22nd, 1918, when Marconi startled the world by sending the first wireless messages from England to Australia.

These wireless waves bearing the messages were sent out at random in all directions at once. This was very useful, especially at sea, for sending messages of distress and calling for help. The fearful disaster of the great vessel *Titanic* in 1912 was to a real extent softened by this means, and many hundreds of lives were saved by vessels that came speeding to the rescue. After that classic catastrophe, all British ships above a certain tonnage

The sending of waves out in every direction has rendered possible modern broadcasting, with all the possibilities of radio The first broadcast was started in 1917, by Captain Donisthorpe, with the help of his wife when training troops at Worcester for the use of wireless in the Great War Every Tuesday night a regular programme of gramophone records was sent out, to relieve the monotony of the men who were listening the whole time for Morse signals

Marconi was very anxious to find some method of sending the waves in whatever direction he wished, instead of the random method This was the disadvantage of long waves, which also have another disadvantage, that they do not travel so well by day as by night In his first experiments on the Atlantic in 1902, he had found that while he could receive signals over a distance of 2,000 miles by night, the same effort would send them only 700 miles by day

So he set to work to invent a method of sending direct messages, what he called a beam system This was 1916, during the war, when such a discovery would have been of immense value to the allies He had begun work on short waves in his early years, but given them up for longer waves with greater power Now he reverted to experiments with short waves In 1924 he discovered that short waves, of about 30 metres in length, could be sent and received over the greatest distances during daylight Short waves have proved themselves capable of being sent by night, even with very little power, over any distance Marconi showed that they are much more obedient than long waves and,

above all, that they can be directed, and sent in a beam, like the beam of light from a searchlight He has stated publicly that this possibility of focussing and directing electric waves of short length, just like beams of light, will become universal.

In 1930, from his yacht *Elektra* in the Gulf of Genoa, he switched on the illumination of the Electrical Exhibition at Sydney, New South Wales

To-day he is working on very short waves, of only half a metre When these are successful, he says, we can scrap our existing telephones

And so Guglielmo Marconi ranks among the greatest inventors the world has seen His name had passed into every language before he was thirty, and monarchs, governments and scientific organizations the whole world over have rivalled one another to do him honour

It is difficult to estimate the importance to mankind of the work of Marconi He has robbed the sea of much of its terror He has contributed more than any other man to make the peoples of the world understand that they are all members of one family And now we are seeing the first offspring of his invention, broadcasting, with all its immense power that it places in the hands of governments, both for good and evil for education and amusement. The next is television. Who can say what the effect of that will be upon our civilization, and how much farther yet we may be taken?

The Romance of Rubber

ABOUT thirty years or more ago there was a familiar anecdote in London about a man who took a cab and paid the driver sixpence too little The old cabbies of London were famous for their vigorous language, and this one resented the mistake, or what he thought was an attempt to swindle him, so he left fly a torrent of oaths The gentleman drew himself up and protested against such terrible language, ending up with a statement of his name in order to impress the cabby with a sense of his dignity

'Do you know who I am?'

'No, and I don't care, so that's that!'

'I am The M'Intosh'

'I don't care if you're the blooming umbrella, but I'm jolly well going to have my sixpence'

It was a natural mistake, for not many Londoners know that it is an ancient Scottish custom for the head of a clan to be referred to in that manner The gentleman was the head of the clan of Intosh, of which the members are known as M'Intosh, or, as it is usually spelt nowadays, Macintosh It was a member of the clan, Charles Macintosh, who first manufactured waterproof garments in England

That was fifty years after the introduction into England of a queer stuff called *indiarubber*

When Christopher Columbus landed at Haiti on his second voyage between 1493 and 1496 he noticed that the natives were playing with balls which they made from the gum of a tree That is

the first known mention of rubber balls, for there cannot be much doubt that that 'gum' referred to was the white juice called *latex*, which oozes out from some trees when cut The natives of South America, we are told, used the same stuff to keep the rain off, and in 1615 Spanish troops in Mexico wore macintoshes!

It is a remarkable thing that it was left to South American semi-savages to show us what a useful thing is rubber, for there are many kinds of trees that give us as good latex in tropical Africa and parts of Asia But the fact remains that until its use was learnt in the New World, the Old World lived without a substance which we now use every day It is remarkable, too, that the Spaniards did not seem to realize how useful rubber could be for they made no attempt to bring it to Europe

Its introduction to the Old World we owe to the French In 1736 the Academy of Sciences of Paris sent a scientific expedition to Peru When it had completed its work one of the party, Charles de la Condamine, set off alone on a remarkable expedition He crossed from Quito to Peru During that journey, in those days very bold and adventurous this courageous and enterprising man observed the use the natives made of the juice of a particular tree, he saw that they protected themselves with it against rain and made bottles and waterproof shoes by smearing a coat of the juice over the material and drying it over a smoky fire Condamine saw how useful this strange juice could be, so he brought samples home, with a full description of the tree

What delayed the growth of its use is the fact



Here we see the method of tapping rubber trees for their latex in Malaya

that the juice thickens of its own accord, and so could not be imported without spoiling Nor could they find any fluid that would dissolve the tough, resilient stuff into which the latex turned

Chemistry was in those days in its infancy, and relatively few substances were known Still, several fluids were found, chiefly by French chemists that would dissolve the latex such as turpentine ether, and, best of all, petroleum A great discovery was made in 1790 by Fourcroy, that the thickening, or coagulation as it is called could be prevented by the addition of an alkali, such as soda or potash, and he suggested that the latex

should be imported into France and a new industry set up

Perhaps owing to the French Revolution and the Napoleonic wars that followed, these researches were forgotten, and another forty years went by before any progress was made with this useful substance, though its properties were by then known to chemists, and a latex very like the American kind had been discovered in Sumatra and Penang in a plant called *Ficus elastica*

By the close of the eighteenth century the only practical use the French had found for it was to rub out pencil marks, and it was first used for this in England in 1770, where it was popularized by Joseph Priestley, the discoverer of oxygen Of course, because it was for this purpose it was called rubber, and because men remembered that we owe it to the miscalled 'Indians' of South America it became known as indiarubber French boys had learnt to play games with rubber-cored balls, which bounced nicely, and rubber catheters had been taken into use in surgery

It was an outside circumstance that led to the birth of the modern rubber industry In 1802 coal gas was used in England for the first time for lighting a house This was so successful and such an improvement on the old, dear and smoky lamps and candles, that gas companies started all over England and Scotland, the result of which was that enormous quantities of coal tar and naphtha were left over, waste products as they were called in those days, before any use could be found for them

In 1819 a coachbuilder named Thomas Hancock

started experiments with rubber to make water proof capes for the stage coaches, which were the chief means of transport in England in those days He quickly found a use for its elastic properties and took out a patent for making gloves, braces garters, shoe soles and sides of elastic, which was so great a success that he found difficulty in getting enough rubber He tried then to make use of the cuttings that were left over, and found the best thing to do was to tear the scrap to pieces and press it into a mould, when it became welded into a tough, solid mass, which was not nearly so difficult to cut This was called masticating it Thus he learnt to make use of what had been wasted, and started new methods of manufacture, and of mixing other substances with it

About this time the Scottish chemist, Charles Macintosh, referred to at the beginning of this chapter, was successfully inventing new processes, especially in making dyes for textiles He found by experiment that naphtha is a good solvent of rubber He took out a patent at once, and started making waterproof coats, which to day bear his name in many languages

Hancock heard of this, and took a licence from Macintosh for the use of naphtha as a solvent He quickly found that by his mastication process he could use solutions twice as strong This gave him such an advantage that Macintosh invited him to join his firm, and become chairman Their business was a great success, and the goods they produced rapidly grew in popularity In 1824, Sir John Franklin used waterproof covers for his boats on his famous Arctic expedition and also for air

mattresses, air pillows and life-belts Other industries awoke to its existence, and a whole range of new uses were found for rubber In 1826 the insurance companies started using rubber instead of leather for the hoses of their fire-engines, and brewers adopted it

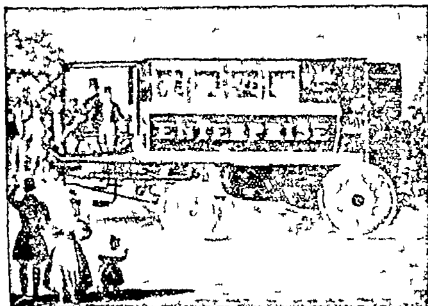
The French, who had been such early pioneers, learnt the new processes from the English, and Hancock started a factory in France in 1828, and the first one in the United States was begun four years later

But the story of rubber is not one of unbroken success, because the public soon found out that rubber becomes hard and stiff in the cold, and soft and sticky when hot This was a nuisance with macintoshes, especially in America, where the extremes of climate are more severe than in England The result was that the pioneers in the United States lost their money

In 1843 Hancock after many experiments, dipped thin strips of rubber in molten sulphur, which, to his delight he found completely changed its character He found, too, that if left long enough in the sulphur, the rubber became hard black and horny In fact, it was what we now call ebonite or vulcanite, and the name given to the process was vulcanization

The baby industry had in 1830 imported only 23 tons of raw rubber In twenty years the amount had risen to 381 tons, and by 1870 it had grown to 7 606 tons Thus, slowly, did the new industry grow up The next big step was the use of rubber to make tyres

A hundred years ago the roads of England were very rough and bad, a fact which hindered the



A contemporary print of Hancock's steam omnibus

development of steam cars ! But in spite of this, Thomas Hancock's brother Walter ran a regular steam 'bus service in London between Paddington and the City, and another was run between Gloucester and Cheltenham Hancock's machine ran at twenty miles an hour on the flat and made journeys as far afield as Birmingham and Marlborough But the heavy tolls on the roads (mostly privately owned), their rough condition and popular prejudice were against it, and the use of steam cars on the roads died away

But it gave rise to the idea that such elastic material as rubber would be useful to put on the wheels to reduce the jolting, and as early as 1845 R W Thompson invented the first pneumatic tyre

He took out a patent, and his tyre was tested in Hyde Park, but people were not interested, and the pneumatic tyre went to sleep for half a century Solid rubber tyres, however, came into general use for vehicles

Bicycles and tricycles were coming into favour about that period, and rubber tyres were used for them, but it was not until 1888 that a Belfast veterinary surgeon named J B Dunlop invented the rubber tyre filled with compressed air It was a success, and at once taken up by racing cyclists There were many difficulties at first, but they were overcome, and in 1895 a motor car fitted with pneumatic tyres was driven in the Bordeaux-Paris trials To-day three-quarters of the world's supply of rubber is used for tyres

The greatly increased demand for rubber raised the question of supply The latex was then tapped by natives from trees growing in the remotest parts, in unhealthy climates, where white men could scarcely live Someone thought of growing the tree in plantations The discovery of a so called *vine rubber in Penang as far back as 1798* showed that it need not be confined to tropical America, and the tree might be cultivated in India or the East Indies Still the need for rubber was not great enough for many years to make the question acute, but in 1855 Hancock consulted the famous botanist Sir J W Hooker, about the possibility of developing supplies in other countries Now, by 1859, Sir Clement *Markham had successfully* introduced the cinchona tree from Peru into India so that the Old World was independent of the wilds of South America for its quinine This

put into his head the idea of doing the same with rubber The tree selected as the best for the purpose is the now famous *Hevea braziliensis* In 1873, 2,000 seeds were sent to be tested by Sir Joseph Hooker at the Royal Botanic Gardens at Kew, but only about a dozen germinated On September 22nd six of these young plants were sent to the Royal Botanic Gardens at Calcutta, and that is the date of the birth of the rubber planting industry in the East Other plants were tried, such as the native Indian *Ficus elastica*, and trees called *Ceara* and *Castilloa*, all of which gives a latex that makes rubber In 1876, W H Wickham chartered a steamer to bring a big supply of *Hevea*, which he contracted to deliver for the price of £10 per thousand seeds On June 14th, at the Royal Botanic Gardens at Kew, he delivered a consignment of 70,000 seeds From them has arisen the greater rubber industry which has brought so much prosperity to the Orient, and enabled the motor industry to proceed full speed ahead

The Glory of Egypt

IN the year 1922 three men and a woman stood and gazed upon a small flight of steps which Egyptian workmen had exposed *They were Lord Carnarvon,* Lady Evelyn Herbert, Mr Howard Carter and Mr Callender

They were seeking what had never yet been found in Egypt, an untouched tomb in the Valley of Kings, where, many centuries previously, the men of ancient Egypt had buried their sovereigns The royal tombs, rich in gold and precious things, had

tempted robbers of all ages, and all the tombs had been rifled of their contents But the explorers felt that surely there must be one left that the defilers had not found, that would be intact, and just as it was left by those ancient officials some twenty or thirty centuries ago, when they sealed it and the royal mourners left their dead Pharaoh to his eternal sleep Those officials knew the danger to their royal dead, so they cunningly concealed the tombs from impious hands

But when Lord Carnarvon and his party had toiled at great expense for five years, shifting the sand and exposing fresh rocky faces without result, they began to feel that their quest was vain They almost gave up hope Still, they decided that they would continue for one more season, and if they found no encouragement then, to abandon the search

Within five days of the opening of the new season they struck the entrance to an unknown tomb

Feverishly they worked, and by November 3rd had discovered a flight of sixteen steps Down these, untrodden by man since they were first cut, with bated breath they went 'It was one of the most exciting moments of my life,' wrote Mr Carter afterwards

At the bottom they found a sealed doorway With trembling hands Carter cut a small hole through the door, thrust through it an electric torch, and peeped

It was an amazing sight that met his eye He saw a small chamber heaped with elaborate, gorgeous gilded and inlaid objects, as that beam lit up strange shapes of animals and statues in every corner



Mr Howard Carter opening the doors of the inner shrine to find the sarcophagus of Tutankhamen

The party gazed through in turn, and for the first time modern eyes rested upon the only royal tomb in Egypt left intact They saw revelation after revelation But it took much labour still and several years' work to reveal, preserve, pack and examine that extraordinary collection of grave furniture, brilliant and glittering, protected in that dark, dry sealed chamber for three thousand years, all retaining its freshness and beauty

Within the sepulchral chamber itself they found a shrine, and within that an inner shrine And then the sarcophagus Within that, three coffins, one within the other, the last of gold, and that contained the royal mummy itself, the very head limbs and bones of long-departed majesty With all respect, these modern men had bridged thirty centuries, and made contact with an ancient romance of a young king and his consort and their brief happiness

There was a beautiful chest of alabaster, standing three feet high, completely overlaid with gold, over it a cornice of sacred cobras Surrounding these were four beautiful statues of the guardian goddesses of the dead, gracious figures, with outstretched protecting arms, so natural and so lifelike in their pose, so pitiful and so compassionate in their faces, that the Englishmen felt it was almost a sacrilege to look upon them The chest was decorated with bas-reliefs of the king with inscriptions in black of passages from the Book of the Dead

Under the lid were four compartments Four beautifully modelled heads of the young king formed the lids to the four compartments, each with a miniature gold coffin shaped like a human figure

delicately inlaid with lapis lazuli These contained the king's internal organs wrapped respectfully in linen As a religious rite, a liquid resembling a kind of pitch had been poured over these four miniature coffins and had become so solid in the course of those centuries that it required long and skilful work to extricate the coffins from it

There were even two tiny coffins of two still-born children It was like intruding upon the privacy of grief

The figure of the king was pre-eminent in delicacy It was, in fact, a portrait, which showed a pleasant little face, not that of a powerful statesman, but with all the signs of inherited nobility, well-set eyes, clear-cut nose, and definite mouth

The catalogue alone of all the beautiful objects interred with them would fill a chapter, a worthy setting for all that is left of Tutankhamen, the young King, with his little Queen, his furniture, all of an astonishing brilliance, witnesses to a world of refinement and beauty unsurpassed in any age

It was an amazing discovery, repaying a thousand times the toil and expenditure lavished upon it By the irony of fate, in the very hour of this triumph of archaelogy, the leader of the party, Lord Carnarvon, died

Mr Carter carried on the work, which threw a flood of light upon life in ancient Egypt at a critical time in her history

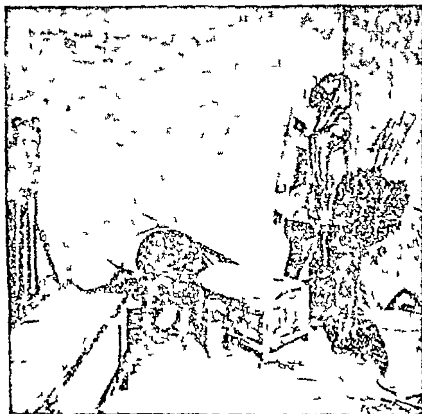
For the young king had lived in exciting times For centuries the Pharaohs, priesthood, and people had been worshipping in their ancient manner, when there came to the throne Amenhotep IV, who had previously been, it seems, High Priest to

Ammon, the Sun-God at Heliopolis He had been so absorbed with the thought of the power of the sun, which he could see with his own eyes was the giver of life and prosperity to the people of Egypt, that when he himself became Pharoah, he abandoned the old religion and forbade the old gods He cut out the name of Re and of Ammon from the inscriptions, even when forming part of the name of his own father, Amenhotep III

His new God was Aton, the Sun's' Disc He dropped the 'Amen' from his own name, and changed it to Akhenaton, the Brilliancy of Aton He abandoned the old capital Thebes, and built himself a new one which he called Khutaton, the Horizon of Aton He found means to do this by seizing the revenues of Ammon, the wealthiest and most powerful of the priestly orders, and he took for the same purpose the tributes from Cush and from distant Syria His new religion was expressed in his poems, which breathed the spirit of the purest monotheism, the worship of only one God

But like many other men moved by the highest and purest motives, Akhenaton was not practical in mundane affairs He squandered the wealth of his country upon his new religion He neglected the defences and military organizations of his empire He roused the hatred of the powerful and wealthy class of the priests of the old gods, and he never reached the hearts of his people

The frescoes of his palace show originality in art In place of the conventional figures customary before his day we see lively pictures of natural life We see waterfowl rising from the reeds, and animals galloping among the papyrus It is like the free



A corner of the tomb with one of the statues of the king

and easy, often amateurish, natural art of ancient Crete, which makes the layman wonder whether Akhenaton's mother were a Cretan

In the year 1350 B C, the seventeenth of his region, Akhenation died He had no sons but left a family of daughters One son-in-law succeeded him, but only for a very short reign and then came a second, a young noble named Tutankhaton Not a fanatic like his father-in-law, he restored the old gods and changed his own name, striking out the allusion to

Aton, and called himself Tutankhamen

It was his tomb that had thus been opened His young and sensitive face was not that of the reforming fanatic He was young when he died, and the eighteenth dynasty came to an end Sixty years after the death of Akhenaton, his religion had been blotted out from the face of the country, his inscriptions defaced, his new capital reduced to ruins The reformer had been too original, and the people reverted to its conservatism

This discovery added greatly to our knowledge of the art of this strangely gifted Egyptian people It was an art which had been diverted to eminently practical purposes It was all subordinated to the demands of Church and State, which were identified Everything was made as tremendous as possible the better to impress upon the common people the might and majesty of Pharaoh They were a strongly conservative people, and for century after century there was little change to be seen in their culture So practical and mundane were they that professional undertakings held tombs prepared and painted, ready to sell to rich clients The entire people was obsessed with the idea of continuity of life after death, and for that reason made their funeral ritual and their tombs as elaborate as they could afford The beauty and the wealth were debased to purely material considerations As one authority upon ancient Egyptian art writes, the vast mass of Egyptian objects of art has the stamp of commercial production The Pharaoh invented mass production and publicity

That brilliant collection of gorgeous objects, piled so carelessly together, is hit off contemptuously by

one authority, as 'the most expensive rubbish that money could buy from the most fashionable furnishers'



A street of private houses excavated at Ur

The Dawn of Civilization

A RATHER short, thick-set, keen-nosed, clean-shaven man wearing a turban comes to pay a call upon the father of Abraham, the Father of the Hebrews

'Across the shaded court he saw with satisfaction through the kitchen door the cauldron steaming on the range, and, shuffling out of his red leather slippers, he entered the guest chamber, to take up a modest seat at the far end, and to be moved up, protesting, to the place where higher-piled cushions bespoke a place of honour Pulling down the

fringed mantles over the skirts of their undergarments, they would sit cross-legged, while a house-slave in short white tunic would bring in plates and cups and set them on a stool at the side of each'

This was in Ur, the town where Abraham spent his youth before he withdrew to the freer, more peaceful life of the nomad with his herds, to found the Jewish people The house, of the well to-do middle-class kind, was comfortable, solidly built of brick, with an open courtyard, as in Spain, and a balcony, supported on brick or wooden pillars, and rooms opening out of it It was rather big, two to three storeys high, with ten or even twenty rooms for households were numerous in the days when men had many wives and slaves There was probably no great luxury but ample comfort, with simple but adequate drainage The houses were clean and whitewashed In that hot climate there was no need for fireplaces so heating when required was provided from a charcoal brazier, as is so common in the East to-day

Lighting was primitive, for they had only a wick floating in a clay saucer of oil Big wooden store chests stood in the store rooms, and for the night there were low wooden bed-steads with handsome ornamented headboards For meals, they had cross-legged tables and couches with straw mats rugs and cushions While the poorer classes had earthenware vessels for their food, the richer families used copper and silver, with gold plates, and rich mosaic of lapis lazuli, the Persian *lajward*

Outside the town was closely packed with narrow winding lanes probably hot and dusty, like many oriental towns to this day, not carefully

planned and laid out like the great city of Nebuchadnezzar nearly a thousand years later The most conspicuous building in the place was a massive hump-shaped structure, 150 feet by 200 feet at the base and 75 feet high, the *ziggurat*, the Tower of Babel It was not the original one built soon after the great Flood nearly two thousand years earlier, but the second one, built by King Ur-Engur about the year 2300 B C, and the base is still standing

Ur was a great city of the kingdom of Larsa, the land of the Sumerians, of flat and reedy plains by the mouth of the great rivers It was already an ancient kingdom in Abraham's days, for a great military cemetery with the bodies of soldiers armed with battle-axes is dated about 3000 B C It was rich, too, for in a mausoleum about the year 2800 B C, in the reign of Bur-Sin, were buried three men, two children and thirteen women, all richly adorned with ornaments of gold In a soldier's grave dating about 3250 B C, touching an axe near the head of a dead soldier, was found a little stone statuette, a female figure about ten inches high, in white alabaster, with eyes of shell and lapis lazuli Was it that of the goddess whom he worshipped? Or could it have been of the woman he loved?

In the reign of Rim-Sin, who flourished about 1920 B C, there lived in Ur a produce merchant by name Es-nasir He was an enterprising man, for he had agents and correspondents in many countries abroad, and carried big stocks of sesame and other grain He also dealt considerably in real property, for in his house have been found many documents dealing with these transactions He was not, however, always lucky, for it seems that he had trouble

with his creditors, and that his mortgagees foreclosed upon him He certainly reduced his style of living

Near by there lived a priest, who was also a teacher, for among the very numerous documents found in his house there were no fewer than 150 school books These are very useful too, for they tell much about life in Ur in those days, but most useful of all is a grammar of the Sumerian language for the use of the Semites who lived there, so now scholars can follow out in detail all the twists and turns of the complex Sumerian verb

Like all the empires of the world in turn, the kingdom of Larsa declined and fell The martial Elamites swooped down upon its wealth from the hills of Iran, sacked the town and looted the rich royal palaces

The Sumerians were great organizers, commercial, practical people, yet very different in character from the more sensual, thoughtful Semites They liked pomp and display, and, though they produced good artists and excellent craftsmen, they were not so much interested in art for its own sake as for its practical value, to impress upon the simple people the power and majesty of the kings

When the Semites obtained the power during the second millennium they adopted Sumerian culture and art, but used it entirely for propaganda and publicity They contributed nothing to what they had taken from the Sumerians They merely used it

When a king died it was necessary to provide for his comfort and safety in the next world, so an armed bodyguard was sent with him, with servants, horses women and slaves all butchered and buried



The ruins of Ur with the *ziggurat* looming in the background

with him in the royal mausoleum A savage custom in our eyes but it persisted in Central Asia, and in Europe survived in Scandinavia down to the ninth century A.D

Thanks to the work done by British and American archælogists in the lower valley of the Euphrates and Tigris, the history of this country and its civilization can now be followed back four thousand years before Christ Sir Leonard Woolley, who has led so much of the work at Ur, thinks it is older than the civilization of Egypt The art of writing can be traced here, from the highly developed wedge-writing, or cuneiform, of Assyria and Babylon, back to the very beginnings of picture-writing at Erech It can be traced right back to the first sign of human life in the Euphrates valley, nearly seven thousand years ago

The work of archæological research is immensely difficult To reach the lowest levels at Jemdet Nasr, dated back about 4000 B C, where the most ancient objects are found no les than 5,000 tons of accumulated rubbish had to be removed

This takes us back to before the great Flood of which we read in the Book of Genesis in the Bible, which drowned out great areas of the country, left eleven feet of silt over Ur, and overwhelmed the lowlands It was after the Flood that the kings built the first *ziggurat* at Ur, probably to provide a refuge from the waters if there came a second flood as great At that distant time they had already, learnt how to make pottery, painted with designs in black and buff They had an elaborate art, with seals, beads stone vases, lions and bulls in relief This last design was persistent all through their history down to much later centuries

Farther north than Ur was Eshnunna to-day called Tel Asmar, fifty miles from Baghdad Here an American party from Chicago dug up an old house dating from about 2500 B C The houses were well built, bordering on a public square The people who lived in them had every comfort, with their pots and pans and handmills, and other household utensils The mistress of the house used rouge, which she kept in mussel shells, and also kohl to blacken her eyebrows, as do women in Central Asia to-day She had combs of ivory, rich bead work, and elegant embroidery and among her things were found lumps of bitumen These were used for making ornaments and utensils inlaid with mother-of-pearl and lapis lazuli They had filigree work, and many precious stones with beads of

carnelion, lapis lazuli and onyx In another place was found a complete service for the great banquets in the temple, with bowls of copper, flasks, lamps, strainers, and silver-hilted daggers, and a perforated drinking-tube But the most surprising find they made at Eshnunna was the modern drainage system, made watertight with bitumen There were comfortable bathrooms, draining into large vaulted sewers under the streets, and lavatories of the European type, with raised seat, not the low oriental type In the lavatory stood a large water vessel, with small dipping-pots

All this elaborate civilization, with the art of dress, of working jewellery and precious metals and stones, of making pottery, of achitecture and sanitary engineering, of carving and writing, arose in the country, and grew out of humble beginnings The oldest remains were found by Dr Mallowan at Tel Arpachiyah The place consisted of humble mud dwellings with small rooms round a central court, of the same character that may be seen in the East to-day Here they already had pottery, based on the design of baskets This pottery takes us back well into the fifth millennium, a good seven thousand years Some is as thin as an egg shell, hand-made and exquisitely finished Here was found a store of wheat, the oldest in the world

Queerest of all were little statuettes of human figures in terra cotta, the women dressed in black and white, with crossed braces behind and in front They wore beads and many stones, with amulets and pendants but the odd thing is that the heads are not shaped, they are merely pegs, as though those early artists shrunk from depicting the human head

Here surely we have the first beginnings of our History

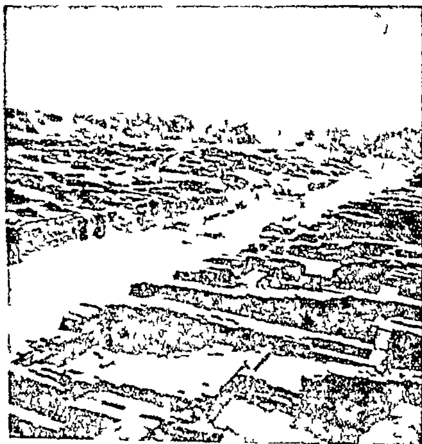
Most Ancient India

IT is a curious thing that, although the history of India is so old, although her literature goes so far back, the oldest buildings known, until quite recently, did not date more than a trifle of some two thousand years ago, to about 300 B C

Then suddenly the spade of the archæologist revealed a far more ancient past buried under the soil in Sind and the Punjab, which at one stroke took back her history ten times as far

Two such places are known to-day, Harappa, in the Montgomery District of the Punjab and Mohenjo Daro in the Larkhana District of Sind In the latter place 240 acres are covered by the ancient remains, and of these thirteen have been opened up and examined in detail

If an Indian of to day were magically transported back five thousand years to that ancient town of Mohenjo Daro, laid open by Sir John Marshall, and described in his great work he would see a splendid city, but yet it would not strike him as so very strange He would see men of various races, some swarthy of skin, others fair, some of the Chinese type, busy on their daily work He would see wheeled carts with supplies of wheat and barley hauled by buffaloes or oxen on broad, straight thoroughfares laid out for a lively traffic, leading into the town from north and south and east and west He would notice dogs basking in the streets as to-day He would meet men coming down the



At Mohenjo Daro one of the broad streets
(Copyright Government of India by permission of Mr Arthur Probsthain)

Great North Road leading strings of camels from the desert lands, or others up the Great South Road with elephants bringing produce from the hot moist districts Outside in the country he would see shepherds tending their flocks of sheep, and swine routing for dainties He would see that the folk were dressed in the same white cotton, much as in India to-day, the women wearing beautiful neck-

laces, with armlets, fillets, girdles, ear-rings and anklets of silver, of gold, of porcelain, of ivory Soldiers would march past him carrying axes on their shoulders with maces and spears and daggers thrust through their girdles, and some with bows and arrows too But he would be surprised that they had no armour, nor did they carry swords Nor had they yet discovered the use of iron They were still in the Age of Bronze

Then perhaps he would be invited inside a house, and at once notice how solidly built it was, with well-made doors and windows, the floors well paved and with good bathrooms, and an excellent drainage system made watertight with bitumen A good dinner would be served to him in good crockery, and he would see at a glance that their pottery was first class, not rough hand-fashioned stuff, but properly made, upon a potter's wheel The men and women of Sind knew how to live in comfort five thousand years ago

His host might ask him to take a letter, for they had the art of writing already, which he would sign with a seal Their seals were beautifully engraved but we have not yet hit upon the secret of reading their script Professor Langden thought that it was the ancestor of the early Brahmi writing of the third century before Christ Those men of ancient days travelled far, for their seals have been found at Kish, in Mesopotamia, in deposits that were there before the days of Sargon. His date is known about 2650 B.C., so there was commerce between northern India and Mesopotamia even in those far off days

This ancient civilization, already so highly

developed fifteen hundred generations ago, is believed to have been built up by the Dravidian peoples, but there were men from Mesopotamia and Armenia, who brought knowledge of the good things of life from the West, where civilization had been developing already for a millennium and a half before the city of Mohenjo Daro reached its prime / Among the human remains found there were those of the Mongolian type, and of the round-headed Alpine type, which to day spreads across Central Asia and Europe, and of the Mediterranean type, which has given to mankind almost all the essential arts But there was one vast difference between the India of those days and the India of to-day The Aryans had not yet come down from the north, and the languages of the great Sanskritic family had not yet been heard in Hindustan

Pekin Man

During the years just after the Great War, a Swedish geologist, Dr Andersson, was working on the fossils of Northern China In 1921 he was busy hunting for old bones with Dr Granger, from the American Museum of Natural History in New York and a Dr Zdansky, when a Chinese came and told them that he knew of a fine place for dragons bones The Chinese know the bones of extinct animals and call them all dragons' bones They think they are good for medicine

So the men of science went to the place It is called Chou K'ou Tien, about 35 miles from Pekin They found a shallow crack in a limestone cliff, filled up with debris from the rock, and fossil bones

Before they had been at work long, they realized that they had *found a site of first-rate importance* that must be worked systematically

While they were busy, a violent rainstorm came on, and the three learned men found themselves cut off in their cave A brook that had trickled below the mouth of the cave was swollen into a raging torrent and washed away the bridge Those men of science *were obliged to wait till the fourth day* before they could reach their home, and to do that they had to strip almost naked and wade through the rushing river

Dr Zdansky stayed there several weeks, examining the cave in detail In one place there was light sandy clay with pieces of sharp quartz in it The *idea entered Dr Andersson's head that these pieces* of quartz were just the sort of stones that primitive man would pick up and use to cut up his food He felt sure they would find remains of early man very early indeed Turning to Dr Zdansky, the Swede tapped on the wall of the cave and said, 'I have a feeling that there lie here the remains of one of our ancestors, and it is only a question of finding him Take your time and stick to it till the cave is emptied, if need be'

So Zdansky continued all that summer, and in *1923 came back to it He found large quantities of* bones of carnivora, that is beasts of prey of dogs, two kinds of bear, a hyæna, a sabre-toothed tiger, a huge cat as big as a lion, together with rhinoceros horse, pig, deer, buffalo and an ape From a study of the bones and the ground, the geologist formed the opinion that the deposit must date from the very beginning of the last period of geological time,



The cave at Chou K ou Tien with the geologists and their assistants at work

what is called the Pleistocene One may say about 500,000 years ago That was just the beginning of the time when central Europe was feeling the advancing chill of the first of the four Ice Ages, and Northern China was passing through a dry period

Zdansky took his material to the museum at Upsala in Sweden to clean and study it In 1926 Dr Andersson in Pekin received a letter from him saying that he had found among it a tooth that looked very human

So Dr Andersson was right!

But not everybody was convinced that it was a real human tooth Some suggested that it might be a worn tooth of some flesh eating animal, some big cat, for instance, or other carnivore, as their teeth somewhat resemble human ones when old

One evening, when some scientific men were holding a meeting in a Chinese restaurant in Pekin Professor Grabau chaffed the Swede

'Well, Dr Andersson' he said, 'how are things now with your Pekin man! Is it a man or a carnivore?'

'I felt the ground was rocking beneath my feet wrote Dr Andersson afterwards when an idea struck him His reply was neat and witty

'My dear Dr Grabau,' he answered smartly 'the latest news from Chou K'ou Tien is that our old friend is neither a man nor a carnivore, but something half-way between the two It is a *lady*!'

And for some time after that it was referred to as the Pekin Lady

The discovery was so important that a young Swedish scientist by name Dr Bohlin went out to

China on purpose to study it carefully and, if possible, find some more material He began on April 16th, 1927 There was a local war in full swing at the time, and troops came marching past the cave, and the thunder of guns could be heard The place swarmed with soldiers and the air was full of stories of the atrocities committed by bandits

But the young Swede paid no attention to all that He went on working steadily at his bones in his cave, all through the summer, patiently and doggedly, but without result At last the autumnal weather made further work impossible, so, on October 17th, he had to pack up and go home But he hated leaving without finding another trace of the Pekin Man, so he stayed just one more day He got his reward He found another tooth

He set off at once for Pekin in a rickshaw, but on his way tumbled right into the local war ' An army was besieging Pekin, and the soldiers stopped, stripped and searched him They took almost everything he had, but not the only thing he had to show for his seven months' hard work, the precious tooth ' He managed to make his way into the city and dashed off at once to show the tooth to the Professor of Anatomy, Dr Black It was pronounced a human tooth, and to it was given the name Chinese Man, *Sinanthropus*

The whole scientific world was excited by this time The Rockefeller Foundation provided funds for further work, and in 1928 the search was undertaken by the Geological Survey of China

The enterprise was rewarded Late in November, Dr Pei had dug deep down, over 70 feet from the floor and found two open holes Into one he

let himself down with a rope, but found nothing of great importance. Into the other he was able to crawl, and on December 1st he began to dig out the sediment. The next afternoon at four o'clock he found an almost complete skull."

Since then the work has continued. During nine years' operations in that cave, at least 10,000 cubic yards of earth have been removed and examined in detail. The result has been to provide science with remains of no fewer than twenty-four individuals of Pekin Man.

The importance of this is tremendous. Our knowledge of the Erect Monkey-Man of Java, *Pithecanthropus* is based on a single fragment of a skull. Even of Neanderthal Man, of the middle of the Old Stone Age, we have only two incomplete skulls, though there are plenty of other bones and of his tools. Very important are the teeth, but the study of the skull tells us much about the owner's brain. But of Pekin Man there is enough material to let us judge the difference due to sex and age. It is the most complete collection of fossil man yet known.

Pekin Man was of a very primitive type. His brain case is far smaller than that of modern man, or even of Neanderthal Man, who lived much later in the middle of the Old Stone Age. But the jaws and teeth are more like those of an ape. He was like a great ape with a big brain, but yet he was a man. He knew the use of fire, of tools rude and rough, but real implements. We cannot choose our ancestors, and Professor Weidenreich maintain firmly that Pekin Man is in our direct line of ancestry. We may not be proud of this coarse and rugged

type, for the bones are in such a state that it can be seen that they are not the bones of the early men who dined in their cave-home, but of the men *upon whom* others dined They are the remains not of the diners, but of the dinners Pekin Man was a cannibal